THE American JOURNAL OF Surgery

SEPTEMBER 1956

THURSTON SCOTT WELTON, M.D., EDITOR

Ground Substance in Surgical Concepts

Cholecystectomy and Common Duct Exploration

Ventricular Fibrillation in Blood Replacement

SIXTY-FIFTH YEAR OF PUBLICATION

SEPTEMBER 1956

THE American JOURNAL OF Surgery

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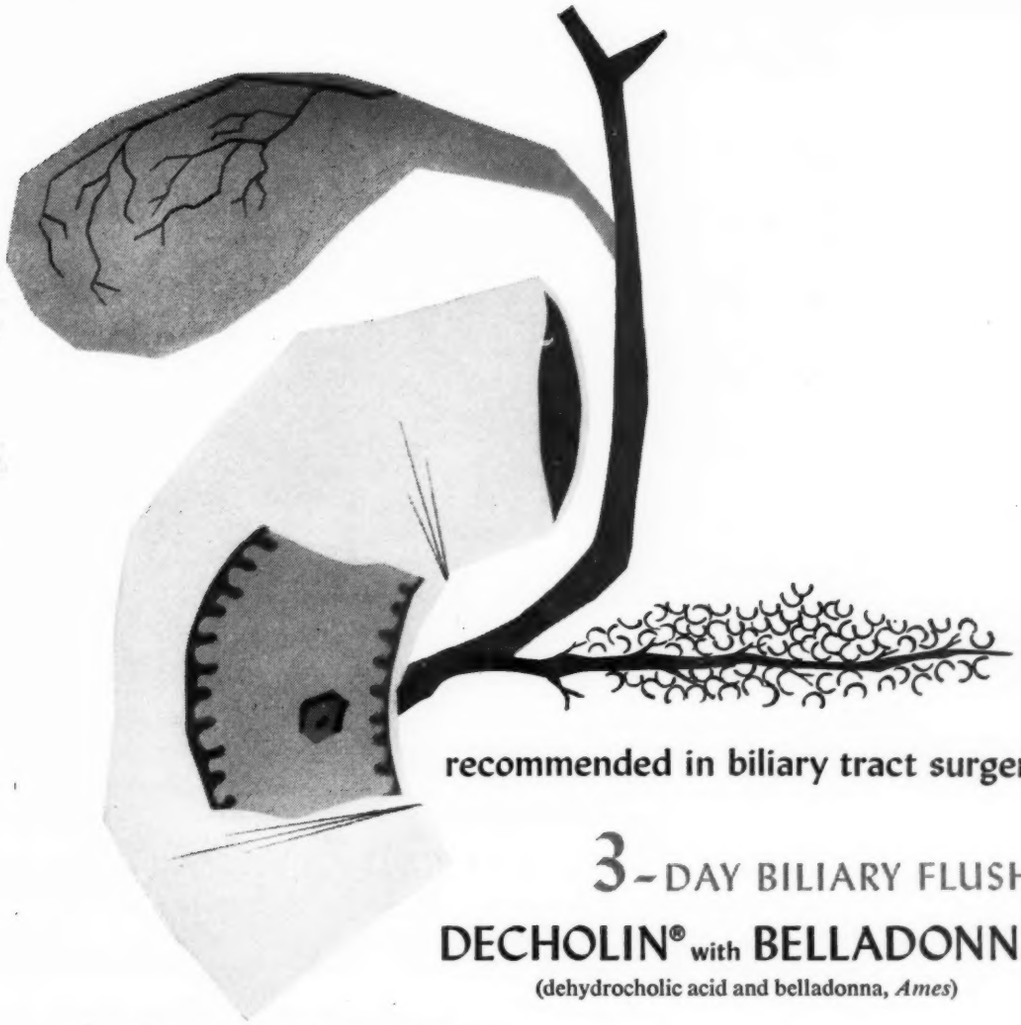

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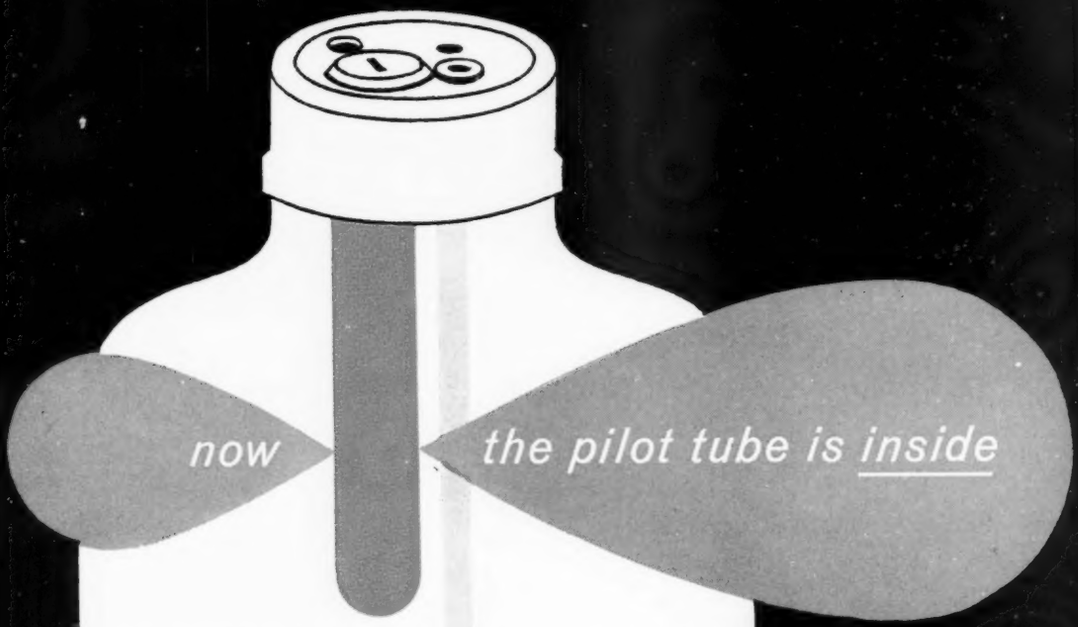

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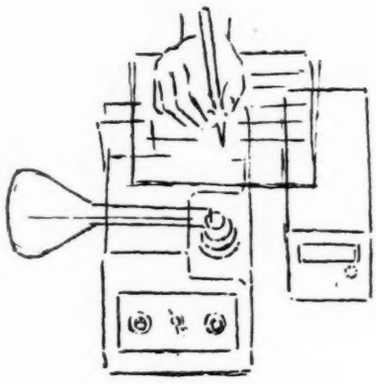

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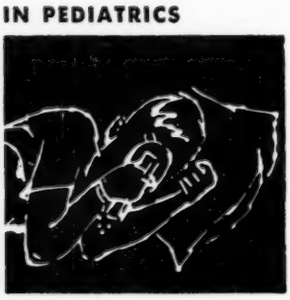

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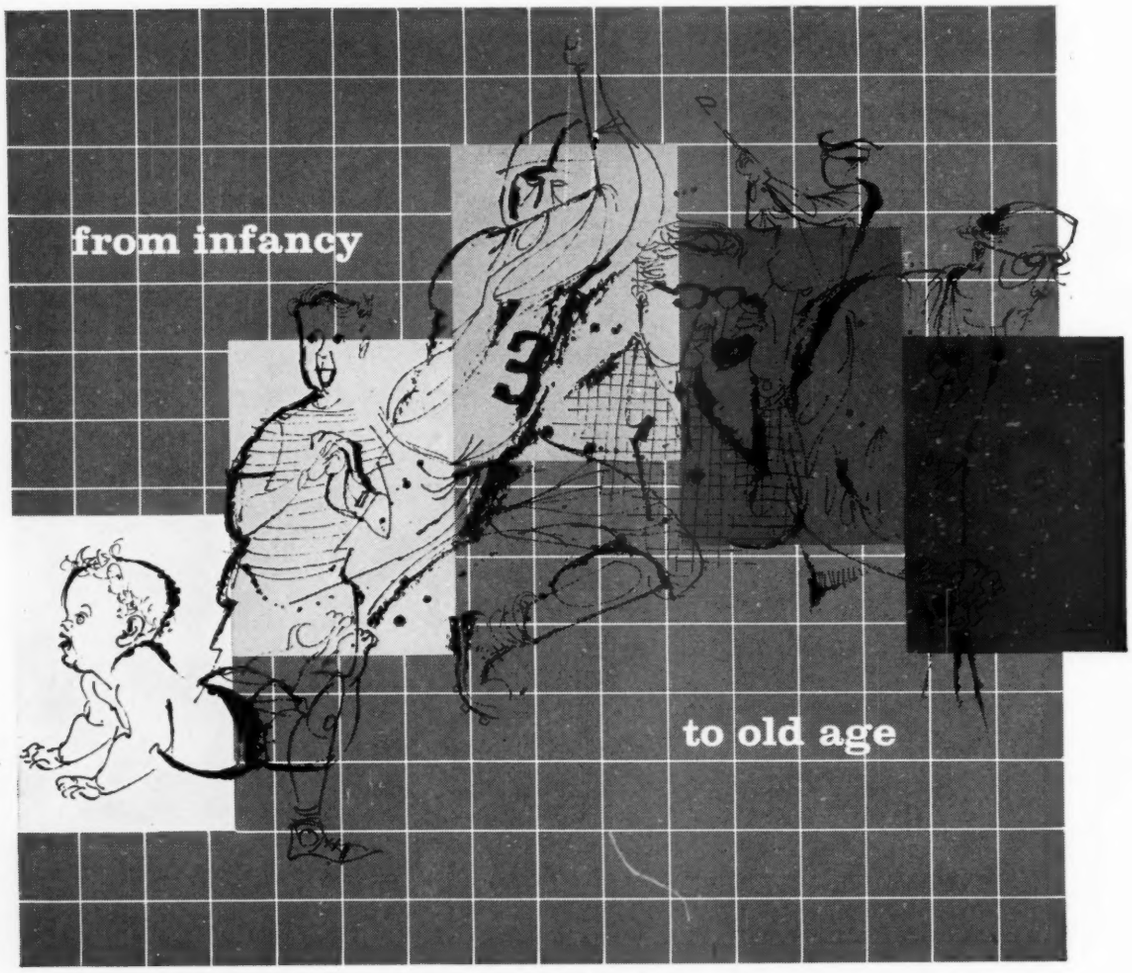

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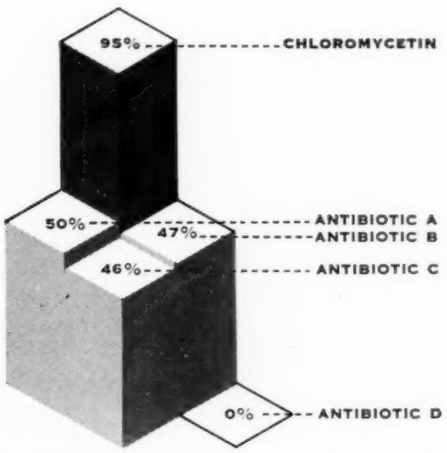

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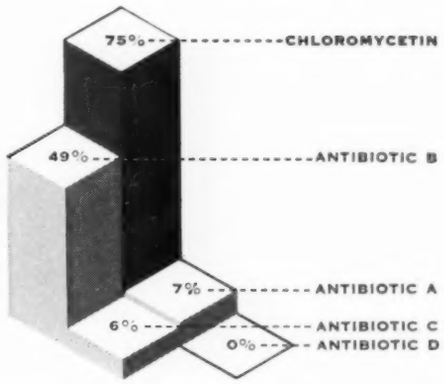

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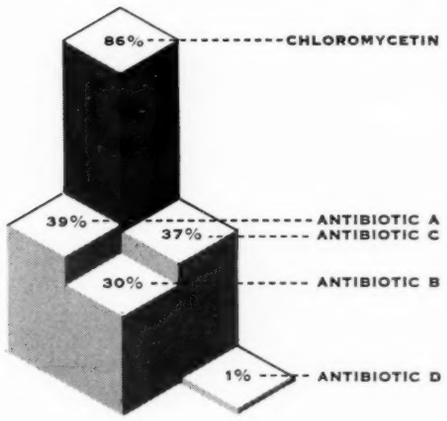

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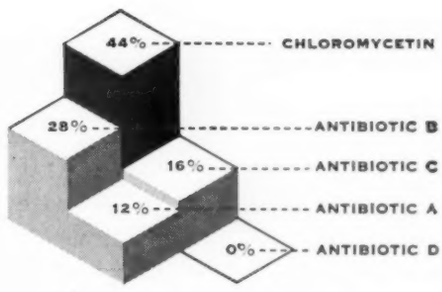

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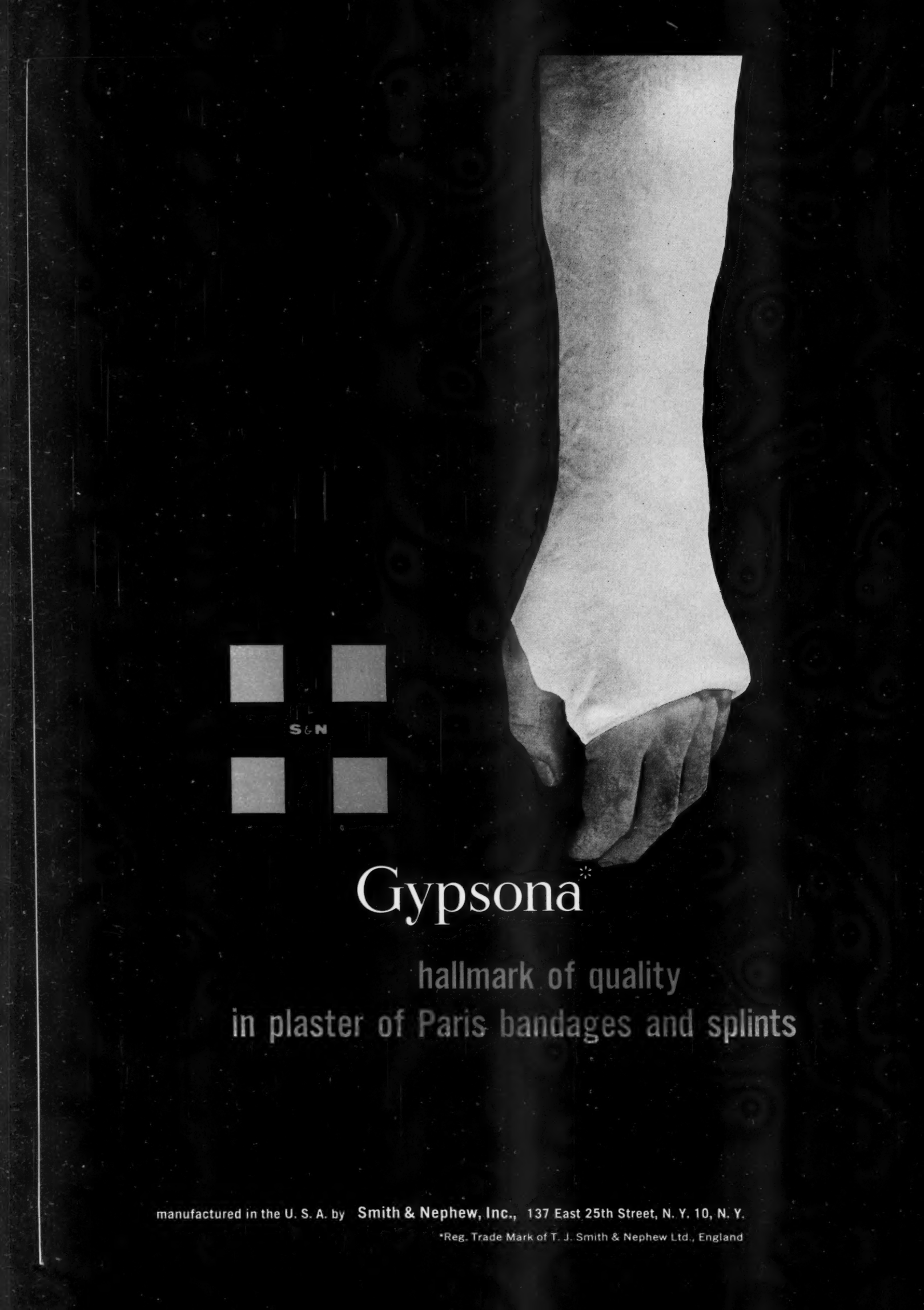

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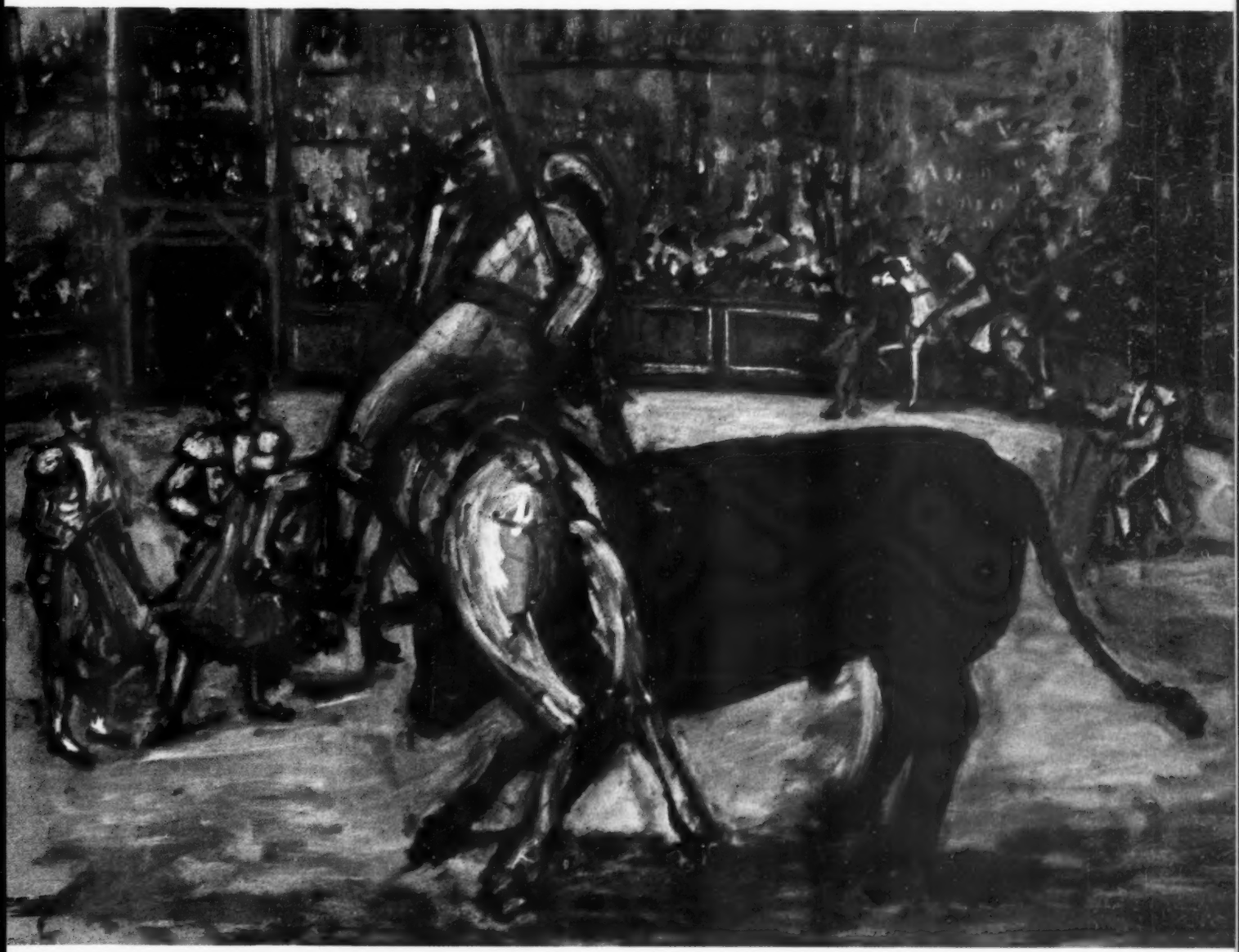

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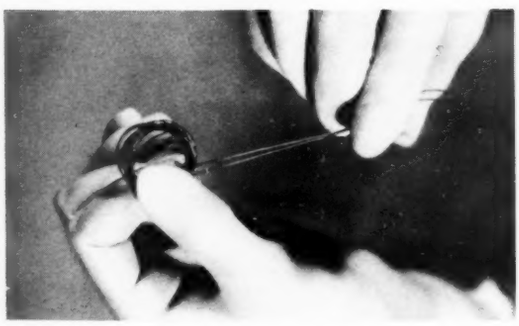

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remarkable

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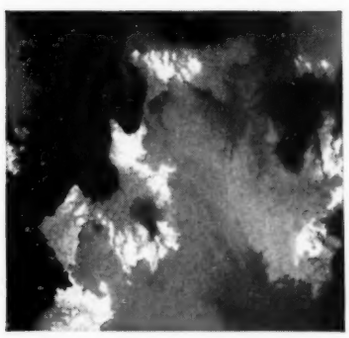
over

inflammation



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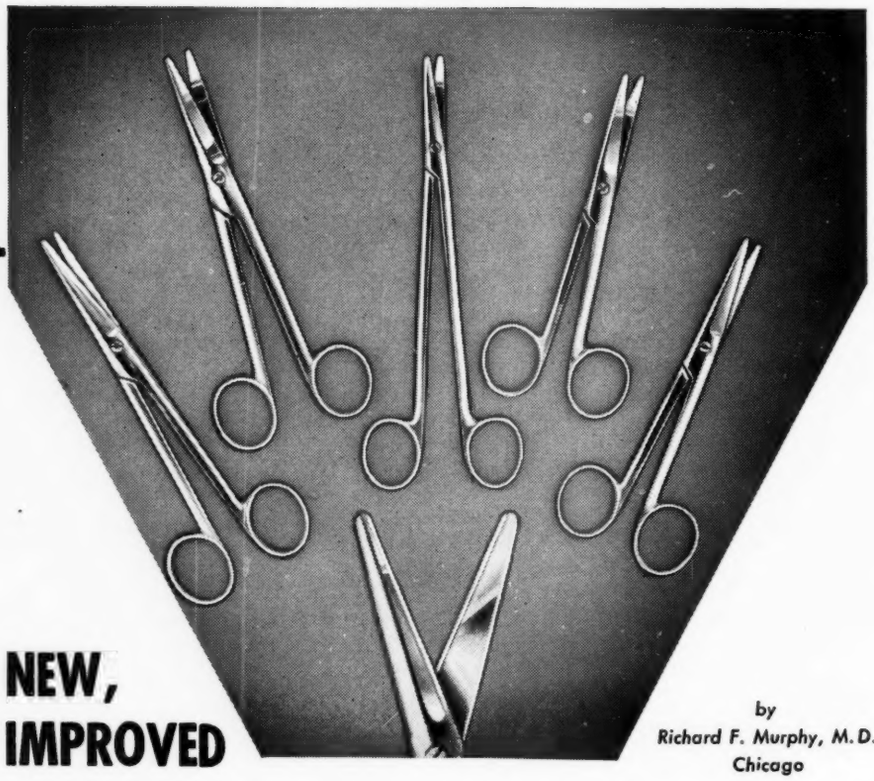

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by
Richard F. Murphy, M.D.
Chicago

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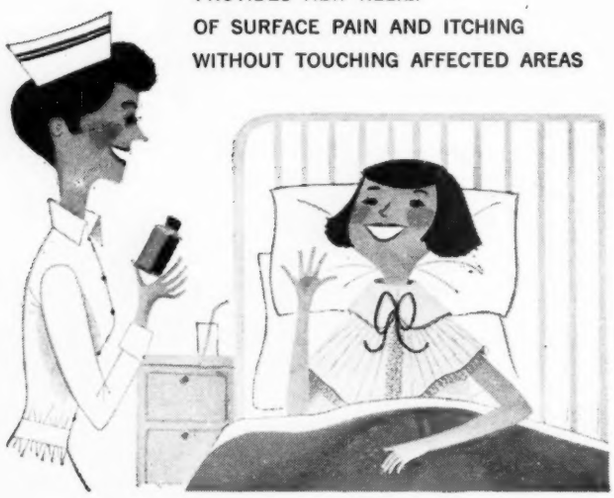

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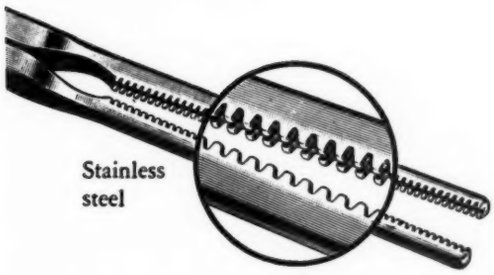

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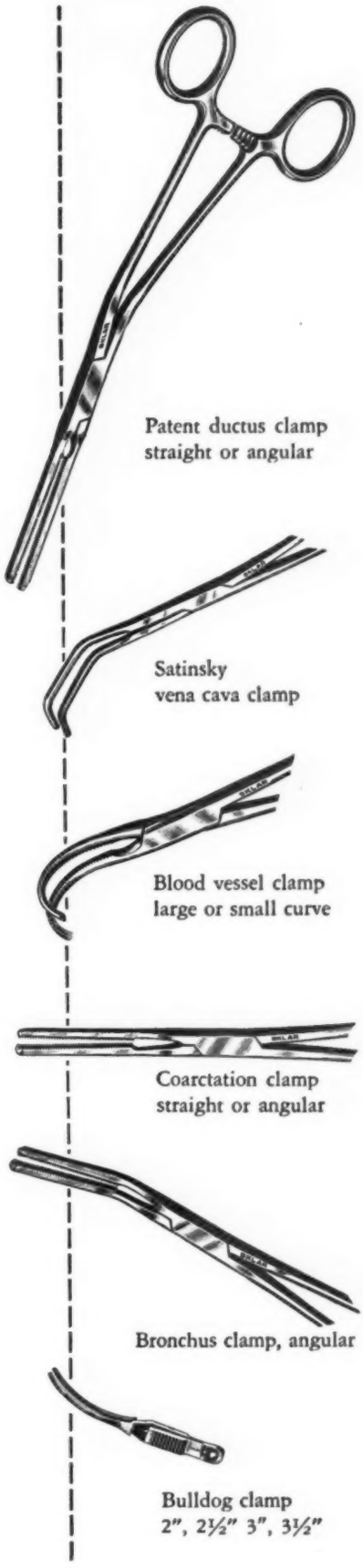


Patent ductus clamp
straight or angular

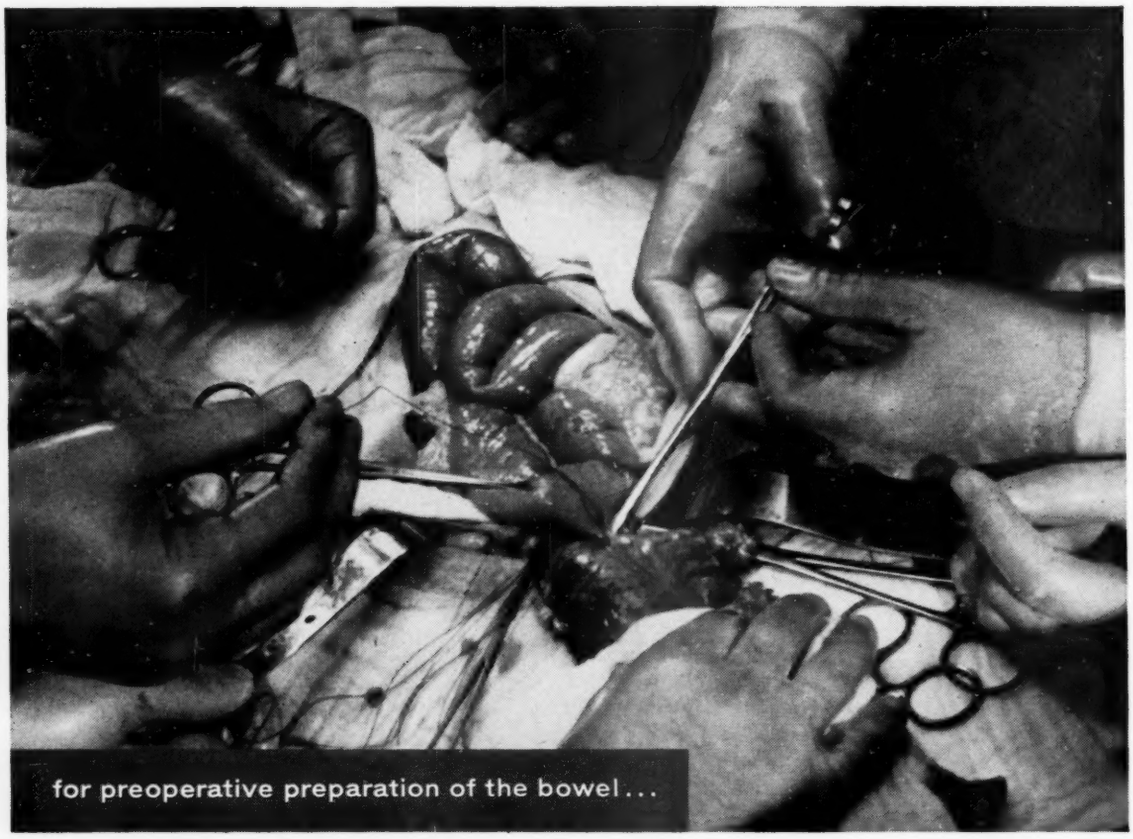
Satinsky
vena cava clamp

Blood vessel clamp
large or small curve

Coarctation clamp
straight or angular

Bronchus clamp, angular

Bulldog clamp
2", 2½" 3", 3½"



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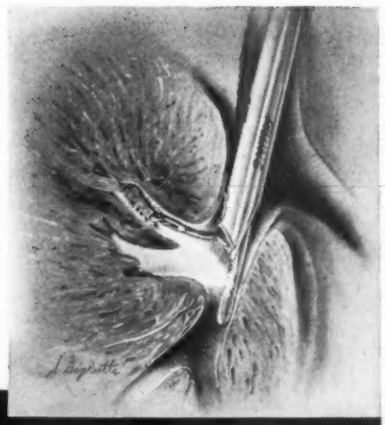

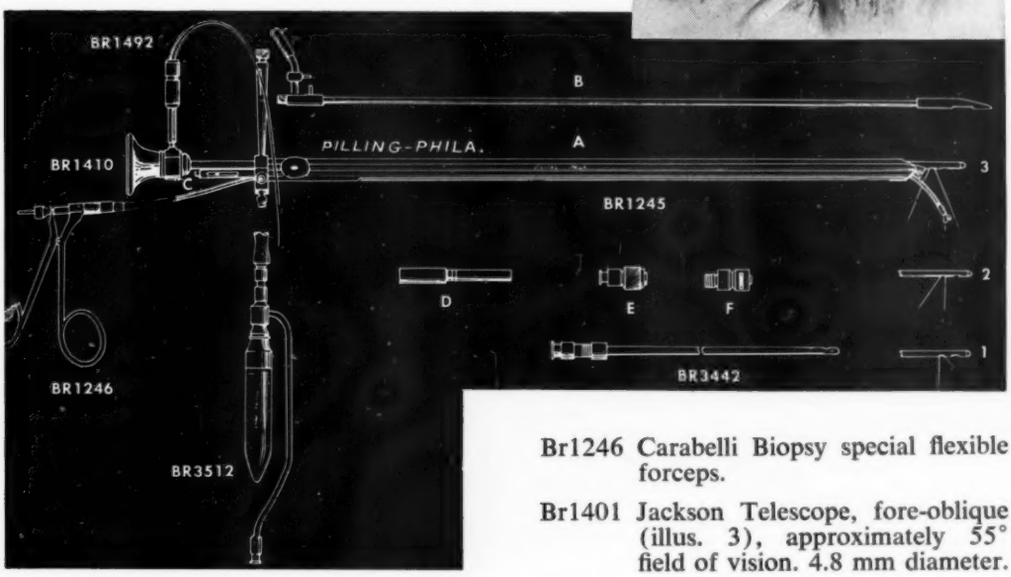

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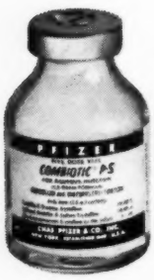

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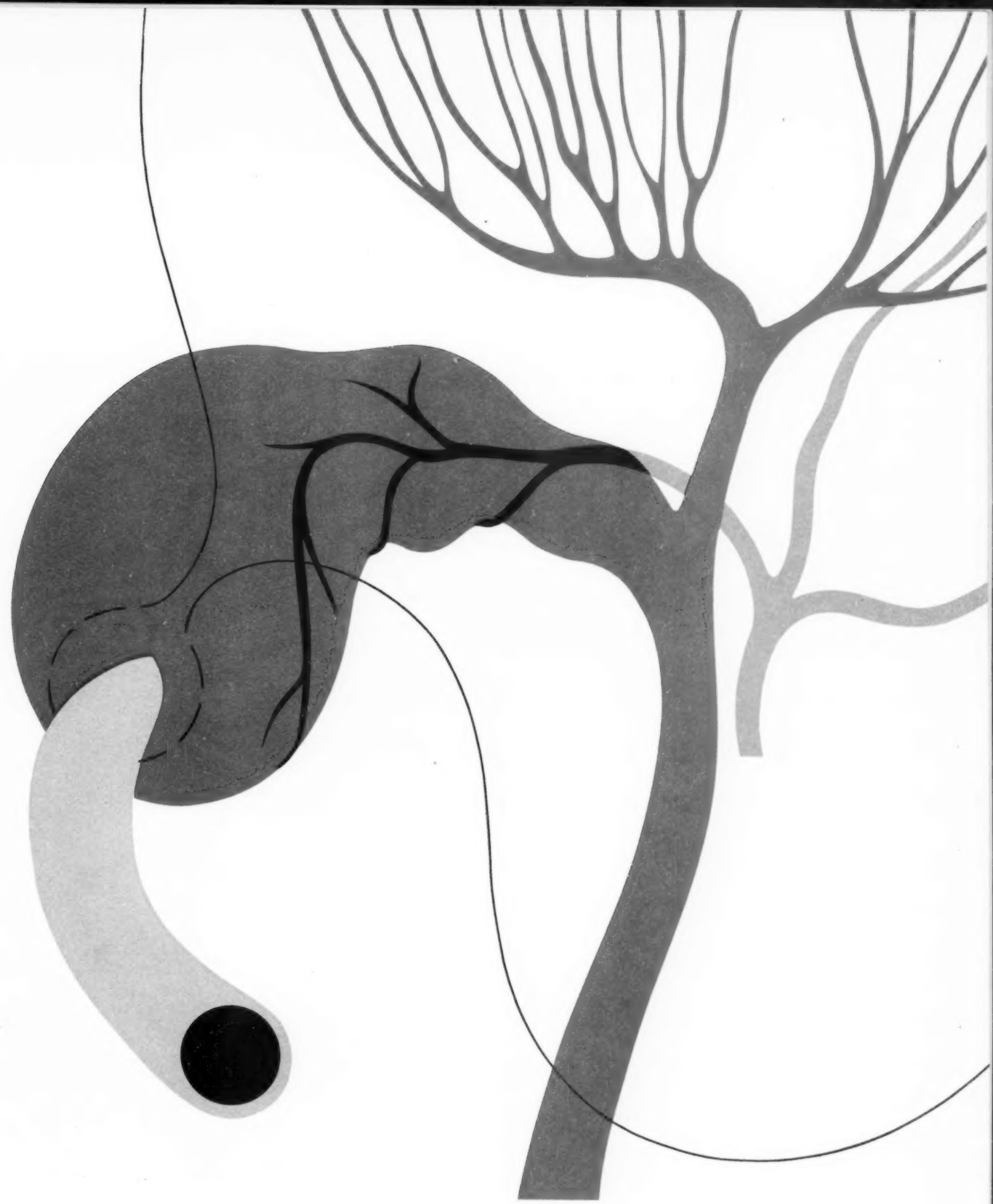

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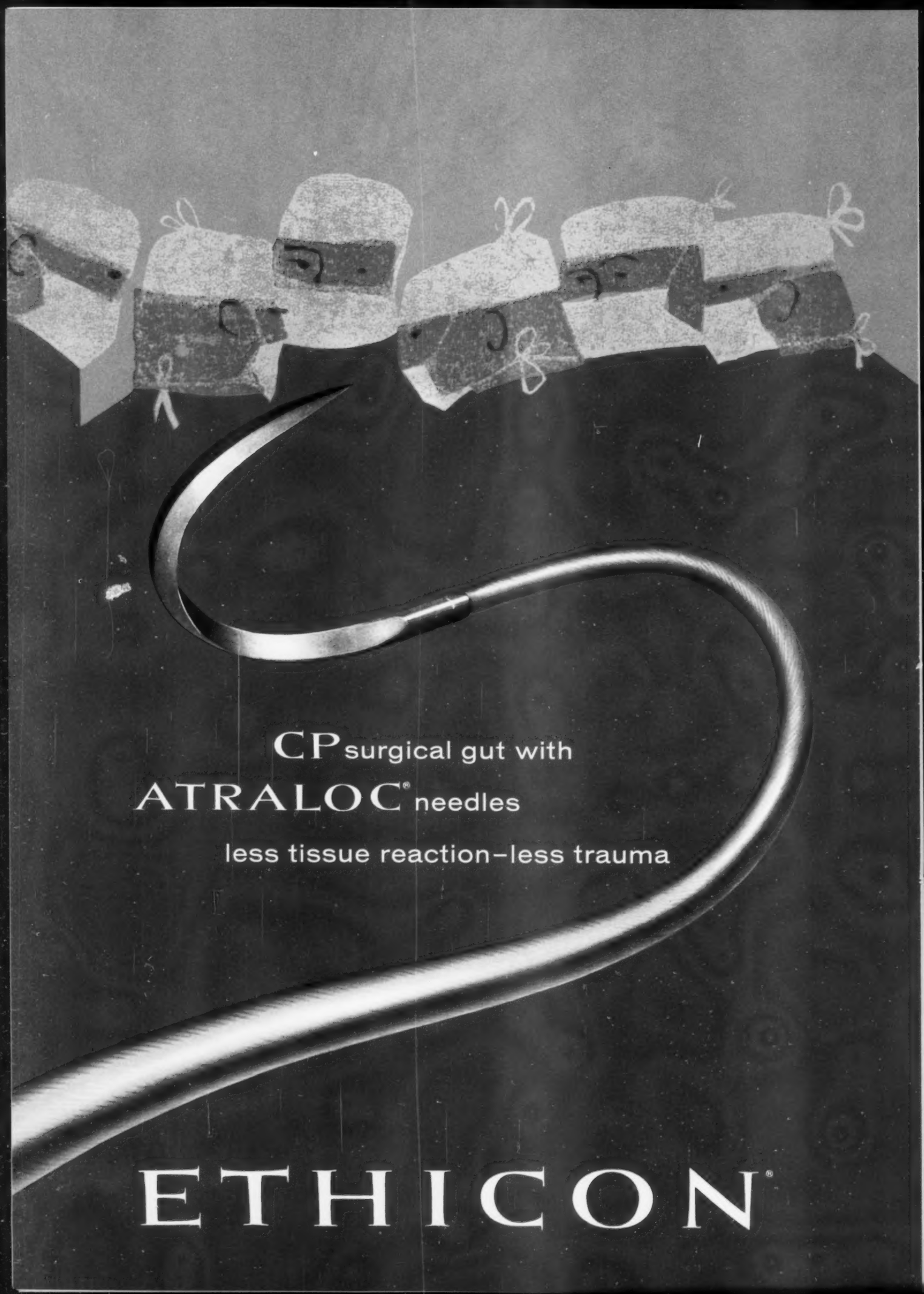
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less tissue reaction–less trauma
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Latest clinical report on **Adrenosem®** *Salicylate*

(brand of carbazochrome salicylate)

The Use of the Systemic Hemostat Carbazochrome Salicylate

J. C. Bacala, M.D.

(Abstracted from the Western Journal of Surgery, Obstetrics, and Gynecology, 64:88 (1956)

The author emphasizes the need for dependable chemical control of bleeding and oozing, and reviews the methods that have been tried to attain hemostasis, including the use of vitamin K and bioflavonoids.

He gives the history of carbazochrome salicylate and describes the clinical work completed to demonstrate its effectiveness. It appears to be specific for conditions characterized by increased capillary permeability. It has no effect on large blood vessels; it does not alter blood components; it does not affect blood pressure or cardiac rate. It has neither vasoconstrictor or vasodilator action. The drug has no known contraindications.

He reviews 1051 cases from the files of St. Anthony Hospital, Louisville, Kentucky, of which 330 were treated with Adrenosem Salicylate. 317 were surgical cases and 13 obstetric-gynecological conditions. The treatment was given for symptomatic relief, and as a clinical recourse for patient safety.

In 1015 tonsillectomy patients the following results were noted: There was bleeding in 85 (19.8%) of 429 patients who received no medication. Patients who received a compound of oxalic and malonic acids numbered 115. Of these 16 (14%), developed bleeding. Of 248 patients receiving vitamin K preparations, 47 (19%) had postoperative hemorrhage. 233 patients received Adrenosem Salicylate. Of this group, only 16 (7%) had bleeding.

In other surgical conditions, Adrenosem was used successfully in gastrointestinal bleeding, cataract extraction, incisional seepage, and transurethral prostatectomy. It was also effective in 12 cases of epistaxis.

In the field of obstetrics and gynecology, Adrenosem controlled bleeding in menometrorrhagia, hymeneal laceration, cervical ooze, antepartum and postpartum bleeding, threatened abortion, and in two cases of surgery during pregnancy.

The author points out that in pregnancy, seepage bleeding occurs more because of capillary permeability, and in spite of increased coagulability. Here, Adrenosem becomes specific for strengthening capillary resistance.

Many of the observations in this study, however, involved bleeding incident to trauma of incision, retraction, dissection, tearing and stretching. In these conditions, he reasons that Adrenosem causes hemostasis by its effect on the capillary intercellular cement substance so that the cells draw closer together, and the ends of the capillaries constrict, causing a "self-clamping" mechanism.

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(*brand of carbazochrome salicylate*)

in the control of bleeding

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Send for comprehensive illustrated brochure describing the action and uses of this unique systemic hemostat.

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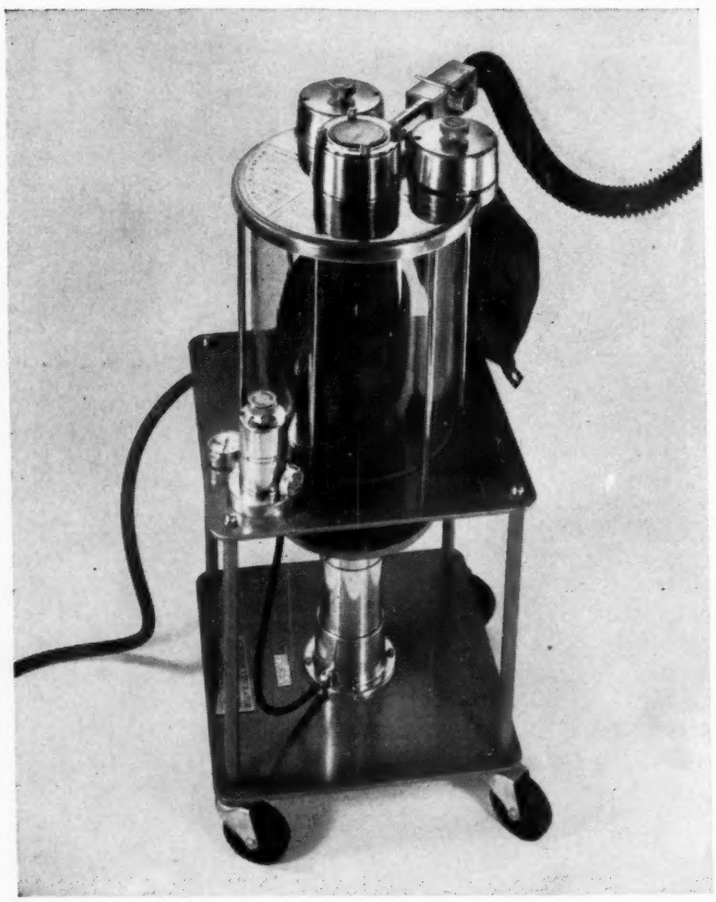

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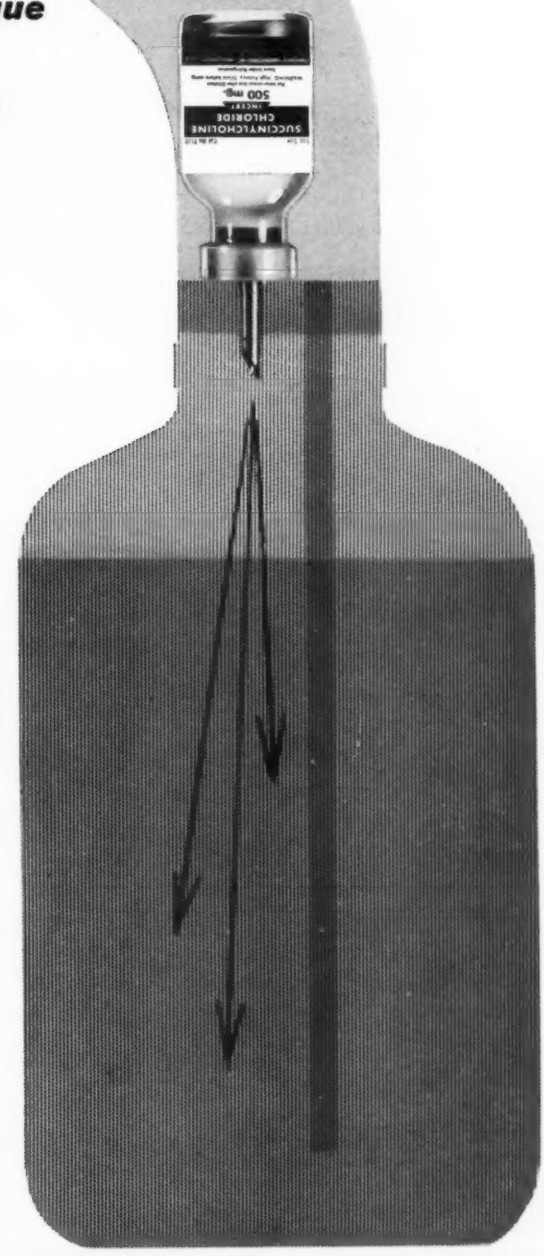

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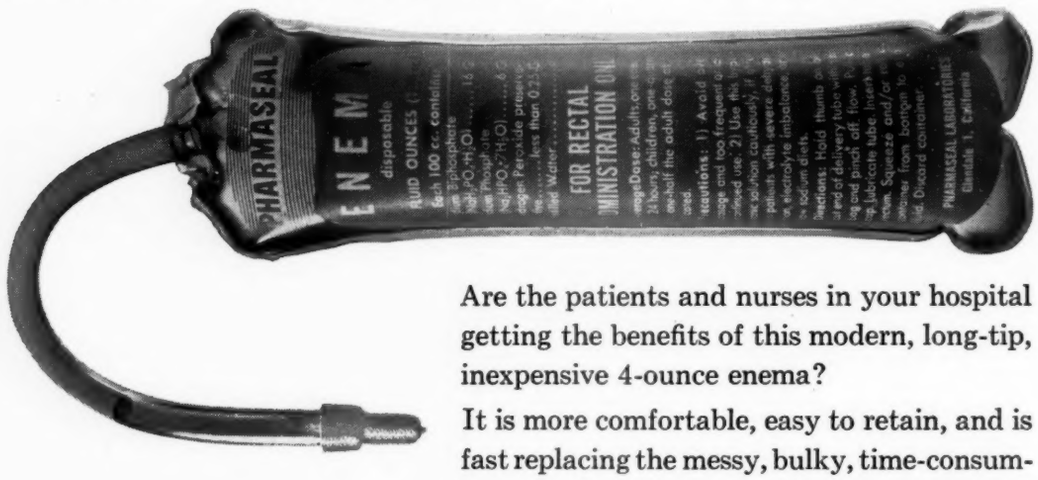

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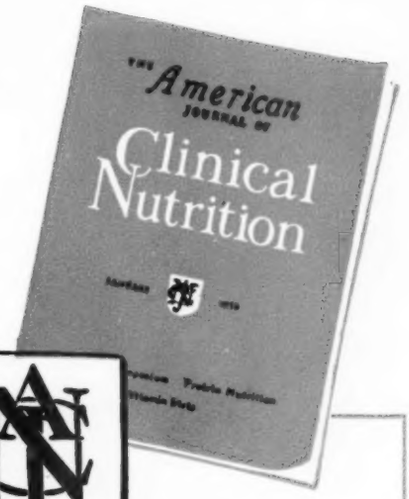

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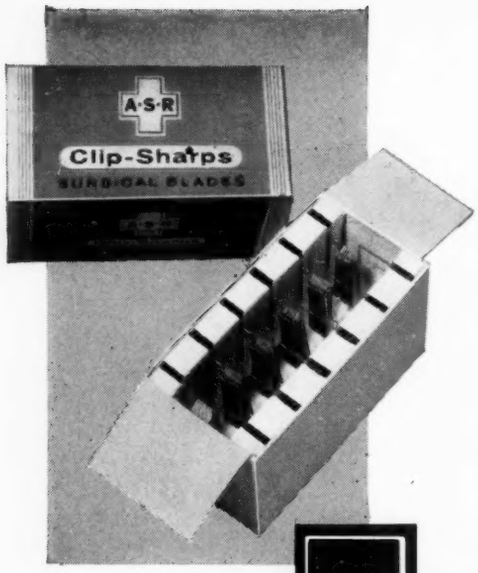

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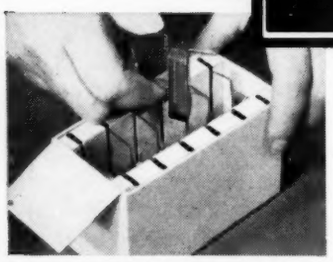

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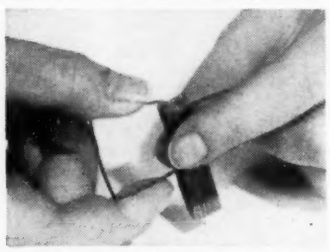

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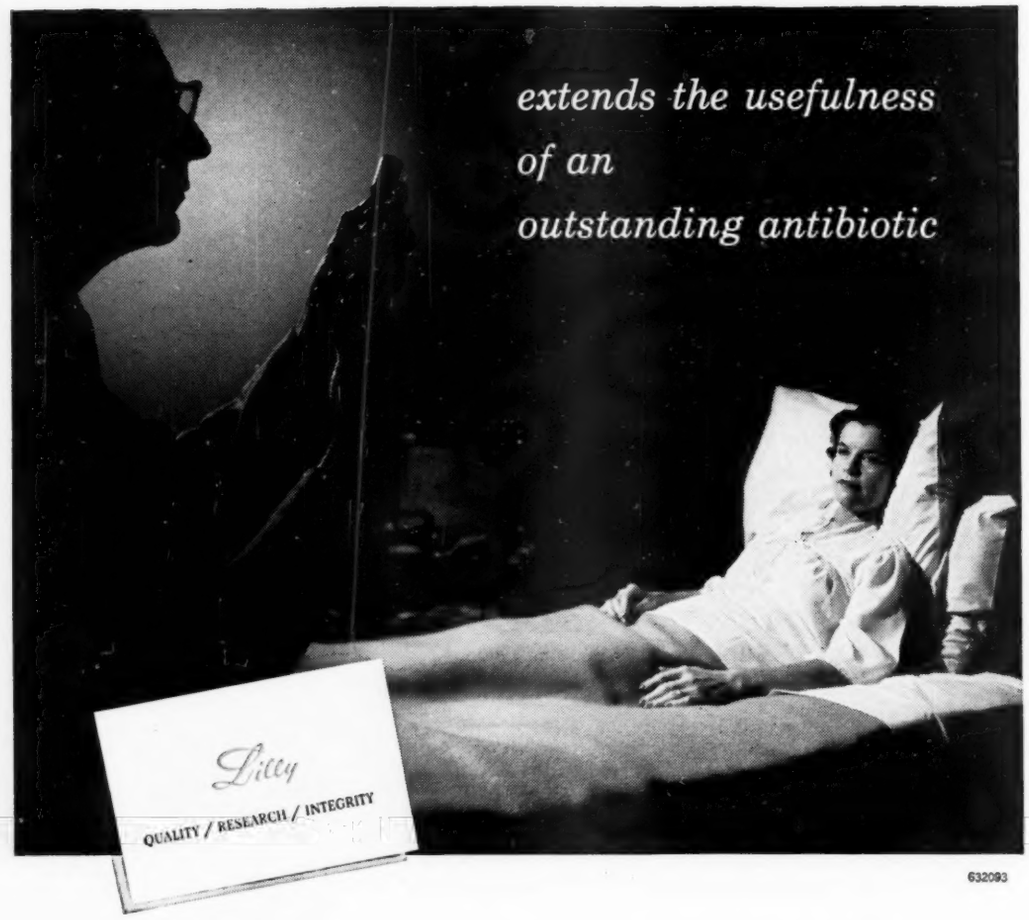

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The American Journal of Surgery

VOLUME 92 SEPTEMBER 1956 NUMBER THREE

EDITORIAL

The Unit of Function

THE living cell must be sustained by an interchange of nutrition and disposal of end products in order to function. The cell must have a blood supply and between the cell and the blood supply lie a basement membrane and intercellular substance. These lie in the pathway between the capillary wall and the cell wall and expedite the interchange. The basement membrane is not merely a passive path and framework; it is living connective tissue. The basement membrane may be reticular fiber or intercellular substance or both. The intercellular substance is an amorphous gel composed of mucopolysaccharides. The gel that holds together the cells of the rapidly growing fertilized ovum is the same material occurring in a relatively large amount. This amount diminishes steadily with age.

The intercellular material is called ground substance by histologists and is known to be the amorphous extracellular component of connective tissue of varying aqueous content. In the basement membrane the gel is in its more solid form; when edema occurs, the ground substance becomes more fluid. The speed of the interchange between cell space and capillary space depends on capillary permeability. Capillary permeability is increased by heat, anoxia, lack of vitamin C, lack of calcium, low pH, and tissue extracts, histamine and leukotaxine. It is decreased by a high pH, calcium salts and adrenal corticosteroids. Leukotaxine, which accompanies inflammation, appears with local tissue damage; tissue extracts appear with distant tissue damage.

The ground substance shuttle area between the cell and the capillary aids the nutritional function of the connective tissue. The connective tissue also acts as an organ of defense involving the ground substance in responses to stress. Any stress that may lead to shock, whether it is hemorrhage, trauma or infection, involves this area.

To understand shock and disorders involving calcification and aging requires knowledge of ground substance physiology. It is an important link in the functional unit of a cell and its blood supply.

Observation leads us to consider that shock may be a device of nature which contributes to the survival of the animal under stress. It is logical that the reduced blood pressure and blood flow of shock would protect an injured animal from exsanguinating hemorrhage. It is also true that in the two centuries before the present era in medicine, physicians used shock-producing methods such as bleeding and purging in the treatment of disease. The modern physician favored with so many means of effective therapy finds it difficult to believe that these methods had any virtue; yet it must be remembered that the great body of physicians who used these methods were applying the prevailing medical knowledge, and with skill and judgment their patients healed. Whether these old methods produced a stupor (or a thorazine-like effect) or whether they altered capillary permeability in a favorable way in the body's battle against disease is a conjecture. However, their use was characteristic of a medical epoch. Even Dr. William Beaumont used bleeding at various times in the treatment of his famous patient, Alexis St. Martin. Dr. Beaumont's care of St. Martin must have con-

tributed to the patient's survival and led Dr. Beaumont to produce the first important observations in gastric physiology in the history of mankind.

The art of medicine is the judicious use of the scientific and empiric knowledge of the time. Today the clinician is the frontline fighter in the battle against disease and organized behind him in this effort are the biologist, the chemist, the pharmacologist, the physicist and other specialists of basic science. As their fields widen and their areas of knowledge overlap, the different specialists find themselves on common ground in the common effort. The clinician who faces the patient's problem must utilize this knowledge and must help to integrate scientific efforts into a single body of knowledge. This requires thinking in basic concepts. The physiologic chemistry of ground substance and the function of connective tissue are necessary concepts of basic science in clinical thinking today.

SIDNEY VERNON, M.D.,
Willimantic, Connecticut

MODERN OPERATIVE TECHNICS

Technic for Cholecystectomy and Common Duct Exploration

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From the Department of Surgery, St. Clare's Hospital, New York, New York.

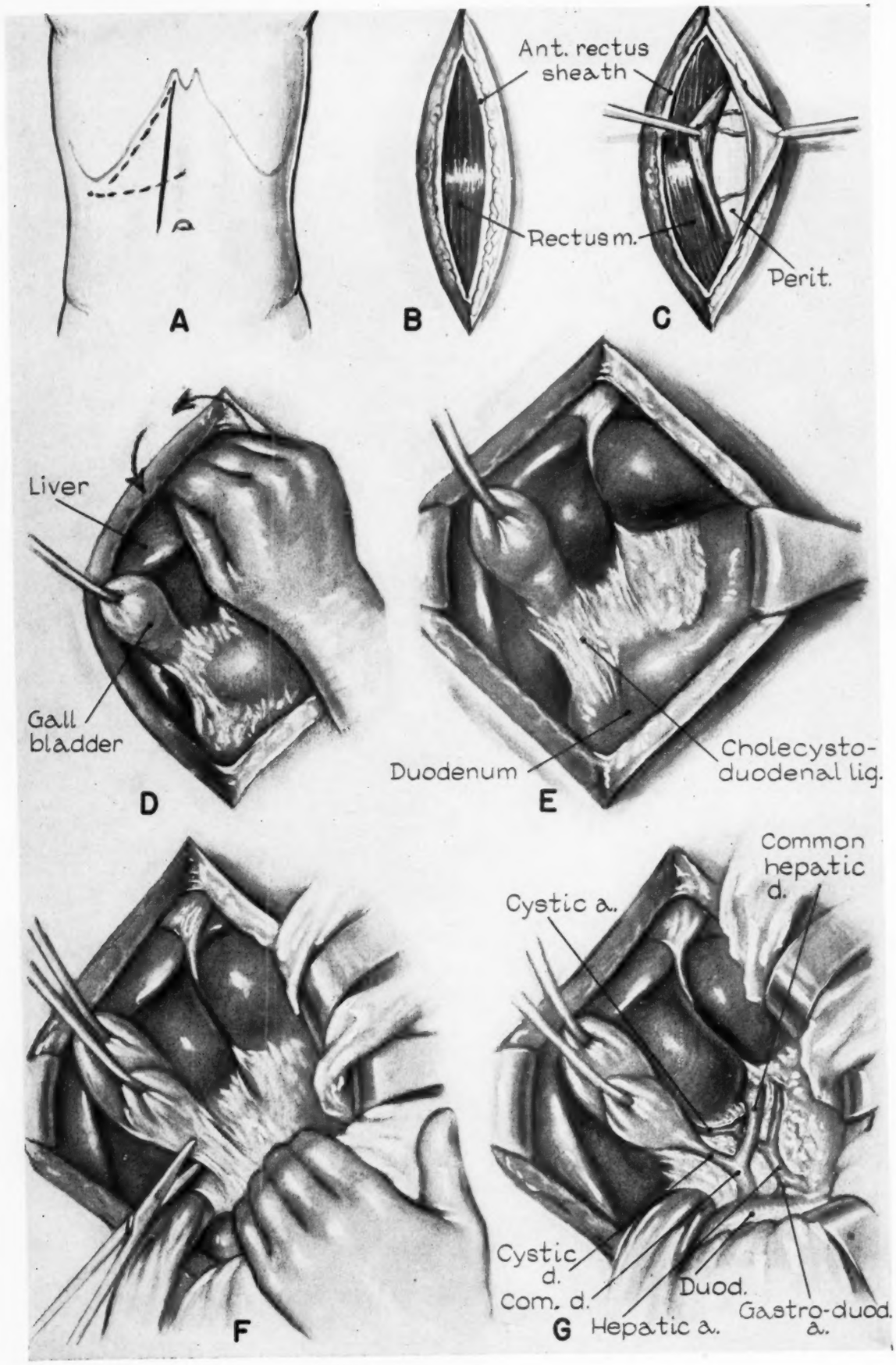
IN this presentation a surgical technic for the performance of cholecystectomy and common duct exploration is illustrated. The artist's illustrations are from sketches made during the actual performance of a series of operations.

SURGICAL TECHNICS

Cholecystectomy. A right paramedian, muscle-retracting (lateral) incision is the one of choice. If preferred, a subcostal or transverse incision may be used. (Fig. 1A, B and C.) Upon entering the peritoneal cavity, systematic and thorough exploration of the intraperitoneal and adjacent retroperitoneal viscera is performed.

In mobilizing the gallbladder the fundus is grasped in a curved clamp (Kelly) and the right hand is inserted over the anterior and superior surfaces of the right lobe of the liver. (Fig. 1D.) By a combination of traction upward on the gallbladder and manual displacement and rotation of the liver, the gallbladder and inferior surface of the liver are readily mobilized into the operative field. (Fig. 1E.) This field is then isolated by the use of three moist gauze pads: one over the stomach, another in the hepatorenal space (Morison's pouch) and a third overlying the transverse colon and the first portion of the duodenum. A portion of a moist gauze sponge is inserted into the foramen of Winslow and a second curved clamp is placed on the gallbladder in the region of its ampulla. By upward traction on the gallbladder and manual (left hand of the assistant) displacement of the duodenum downward, the cholecystoduodenal ligament is made taut preparatory to its division by scissor dissection. (Fig. 1F.) The dissection is continued in the underlying fatty areolar tissue to expose clearly the cystic duct and cystic artery. (Fig. 1G.) The whole length of the cystic duct and its junction with the common hepatic duct is clearly seen before the application of either clamp or ligature. Similarly, the origin of the cystic artery from the convex arch formed by the right hepatic artery is demonstrated routinely (Figs. 1E, and 2H and I.)

The isolated cystic duct is doubly clamped


A
B
Ant. rectus sheath
Rectus m.
C
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Liver
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E
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Common hepatic d.
Cystic a.
Cystic d.
Com. d.
Hepatic a.
Duod.
Gastro-duod. a.
G

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FIG. 1.

and severed. (Fig. 2H.) The distal end is occluded with a ligature of No. 000 silk as the clamp is temporarily released. The clamp is again locked and a distal transfixion ligature of No. 000 silk is inserted between the ligature and the clamp. (Fig. 2H′.) Similarly, the cystic artery is doubly clamped (Fig. 2I), severed and occluded proximally with both a ligature and a transfixion suture ligature of No. 000 silk. (Fig. 2L and O.) Each structure is treated definitively to avoid an excess of clamps in the operative field. If preferred, occluding ligatures of silk may be applied to both the cystic duct and cystic artery prior to the application of clamps. (Fig. 2J.) This is practiced by many as it is considered safer, should the ligature break while it is being tied.

Upon completion of the ligation and division of the cystic duct and cystic artery, incisions are made through the peritoneal covering on either side of the gallbladder in juxtaposition to its attachment to the undersurface of the liver. (Figs. 2O and 3P.) With the maintenance of traction upward on the gallbladder, it is mobilized from its liver bed by a combination of scissor and blunt digital dissection. (Fig. 3P′, Q and R.) During this maneuver one should be cognizant of the possible presence of an accessory bile duct entering the gallbladder bed. A branch from this duct may be inadvertently severed during the removal of the gallbladder and require ligation. This finding as obtained at operation is depicted in Figure 3R. Prior to the severance of the peritoneal attachment of the fundus to the liver, the liver bed of the gallbladder is inspected carefully for areas of active bleeding. If present, hemostasis is obtained with suture ligatures of No. 000 silk. (Fig. 3S.) This is preferred to the use of an absorbable hemostatic gauze sponge. When hemostasis is complete, the vascular peritoneal attachment of the gallbladder to the liver is clamped and severed. (Fig. 3U.) Peritonization of the gallbladder bed, although a surgical refinement, is not considered of practical importance. Accordingly, it is infrequently performed. (Fig. 3T.) In fact, an open gallbladder bed is preferred. (Fig. 5J.) A Penrose (cigarette) drain is inserted into the foramen of Winslow (Fig. 3W) and a layer closure of the wound with interrupted sutures of Nos. 00 and 000 silk is performed. The exit of the drain through the incision (Fig. 5K) is preferred to a stab wound toward the flank.

In the presence of acute cholecystitis a preliminary decompression of the tense and distended gallbladder may be required. (Fig. 4B.) When this occurs, the operative field is walled off completely with moist gauze pads to minimize contamination of the surrounding area. In the acute stage, removal of the gallbladder from above downward may be preferred. Accordingly, incisions are made through the peritoneal covering of the fundus and the sides of

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FIG. 1. Cholecystectomy. A, an oblique right paramedian, muscle-retracting (lateral) incision, depicted by the solid black line, is the one of choice. If preferred, either a subcostal or transverse incision, as shown in dotted outline, may be used. B and C, the anterior rectus sheath is incised and the medial border of the right rectus muscle is mobilized by a combination of sharp and blunt dissection from its midline attachment and retracted laterally. Accordingly, the nerve supply to the muscle is not interrupted. D, a curved (Kelly) clamp is placed upon the fundus of the gallbladder and the right hand is inserted over the dome of the right lobe of the liver into the subphrenic space. The clamp on the gallbladder is held in the left hand; while traction is maintained upward, the right hand is used to rotate manually both the inferior surface of the liver and the gallbladder into the operative field (E). F, to isolate the operative field three medium-sized moist gauze pads are used. One is placed over the anterior surface of the stomach, another is inserted into the hepatorenal (Morison) space, and a third is placed over the transverse colon and the first portion of the duodenum. A second curved (Kelly) clamp is placed upon the gallbladder in the region of its ampulla; and with traction maintained upward, the cholecystoduodenal ligament is made taut prior to its division by scissor dissection. G, dissection of the cholecystoduodenal ligament is completed to expose both the cystic duct and artery and their related structures. The long cystic duct and the origin of the cystic artery from the convex arch formed by the right hepatic artery are clearly visible.

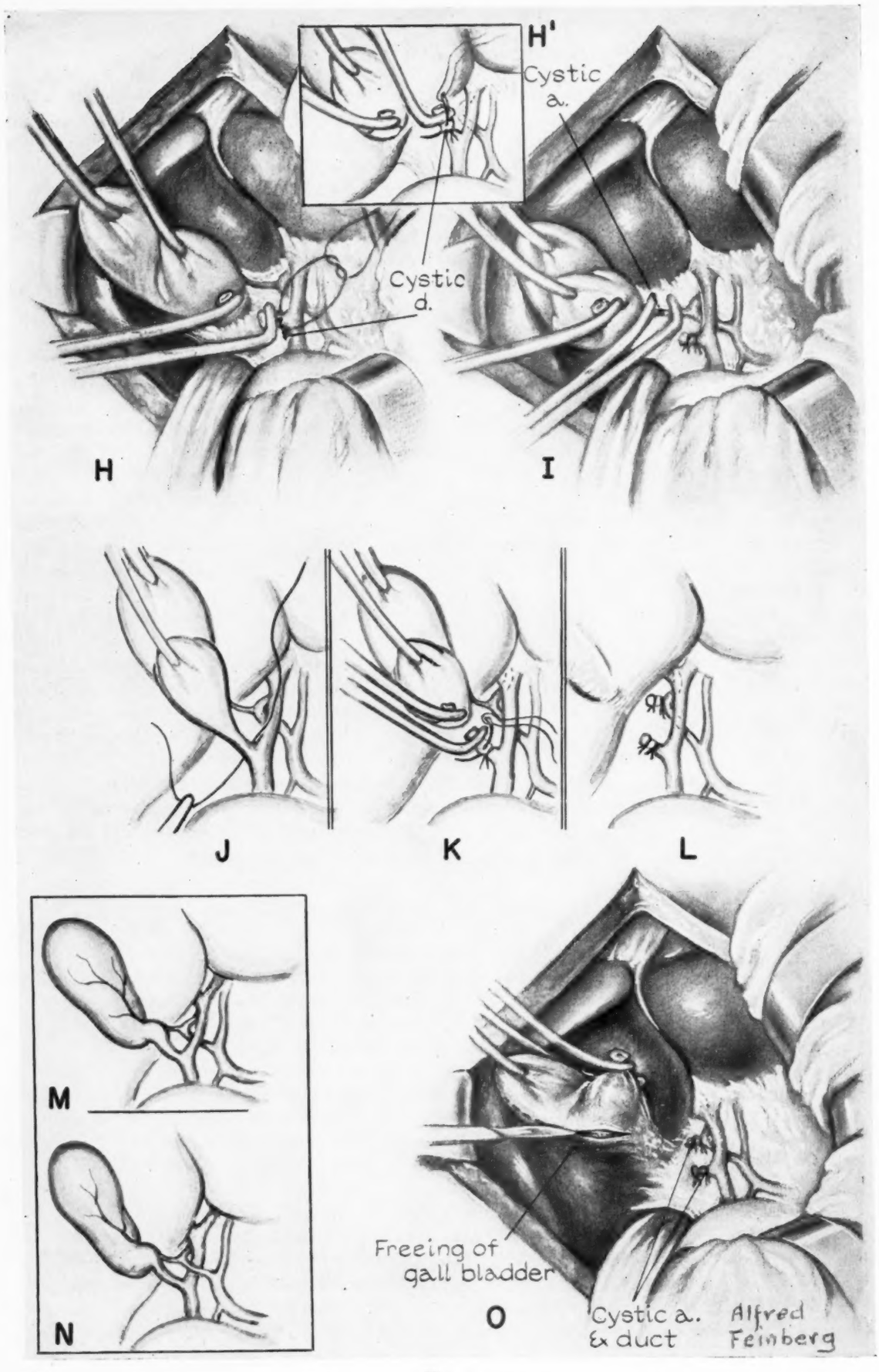
H'
Cystic a.
Cystic d.
H
I
J
K
L
M
N
Freeing of gall bladder
O
Cystic a. & duct
Alfred Feinberg

FIG. 2.

the gallbladder immediately adjacent to the liver surface. (Fig. 4C.) A cleavage plane is obtained in the edematous tissue between the gallbladder and the liver bed. By a combination of blunt digital and scissor dissection (Fig. 4D and E) the gallbladder is mobilized down to the region of its ampulla and the cystic artery. The dissection is then continued anteriorly (Fig. 4F) until the gallbladder is completely mobilized and its only remaining attachments, the cystic artery and the cystic duct, are clearly seen. (Fig. 5G.) These structures are individually doubly clamped, divided and occluded with ligatures and suture ligatures of No. 000 silk. (Fig. 5H and I.) A drain is inserted into the foramen of Winslow (Fig. 5J) and the wound is closed in layers (Fig. 5K); this completes the operation.

Common Duct Exploration. In exploring the common duct, particularly in secondary operations on the biliary tract, a technical expediency is the immediate mobilization of the hepatic flexure of the colon by division of the right phrenocolic ligament. (Fig. 6A.) This maneuver exposes the entire retrocolic portion of the duodenum, which is in turn mobilized by severing the posterior parietal peritoneum along its lateral border. (Fig. 6B.) By digital dissection in the avascular tissue plane behind the duodenum and the head of the pancreas, the second portion of the duodenum is readily mobilized and rotated toward the midline. (Fig. 6C and D.) In this dissection one must be careful to avoid injury to the subjacent inferior vena cava and its tributary, the eccentrically placed spermatic or ovarian vein. (Fig. 6D.) When the mobilization of the duodenum is completed, the entire terminal portion of the common bile duct and its entrance into the posteromedial aspect of the second portion of the duodenum is visible and readily palpable. (Fig. 7E.)

To explore the common duct, traction guy sutures of No. 00000 arterial silk on a minimum trauma needle are inserted into the wall of the duct to either side of the proposed incision. (Fig. 7E.) When the duct is opened, guy sutures of No. 00000 arterial silk are inserted through the cut margins (Fig. 7E′), and the previously placed traction sutures in the wall of the duct are removed. Instrumental (scoop) exploration is performed, first proximally into the common hepatic duct and the right and left hepatic ducts, and then distally in the common bile duct toward the duodenum. (Fig. 7F.) To aid in the detection of small stones, palpation along the outside of the common duct against a probe within its lumen is performed. (Fig. 7E.) If stones are detected they are removed with a scoop (Fig. 7F) or a fine stone-grasping forceps. Subsequently the exploration is continued with a series of graded sizes of Bakes dilators. (Fig. 7H.) This is begun with a dilator 4 mm. in size, and an attempt is made to insert it through the papilla of Vater into the lumen of the duodenum. If

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FIG. 2. H, H′ and I, the cystic duct and the cystic artery are individually doubly clamped and severed and the proximal ends are occluded with both ligatures and transfixion suture ligatures of No. 000 silk. To facilitate the division of the cystic duct a right angled (Mixter) clamp is applied distally and a curved (Kelly) clamp is applied proximally. J, if preferred, the distal ligatures may be applied prior to the application of clamps to either the cystic duct or artery. K and L, the cystic duct and cystic artery are in turn doubly clamped and severed, and transfixion sutures of No. 000 silk are inserted as previously described. M, an unusually short cystic artery which permitted the application of only one clamp proximal to which the artery was divided. N, the right hepatic artery courses anterior to the common hepatic duct and from its convex arch a short cystic artery arises. This anatomic finding demonstrates the absolute necessity for careful tissue dissection and the individual isolation of structures to lessen the chance of injury to the right hepatic artery. Whenever the cystic artery is either shorter than the cystic duct (M) or anterior to the common hepatic duct (N), it is clamped and severed first. If this precaution is not observed, there is danger of an avulsion tear of the artery with resultant hemorrhage. O, upon completion of the severance and ligation of both the cystic duct and cystic artery, traction is maintained upward on the gallbladder and an incision is made through its peritoneal covering in juxtaposition to the inferior surface of the liver.

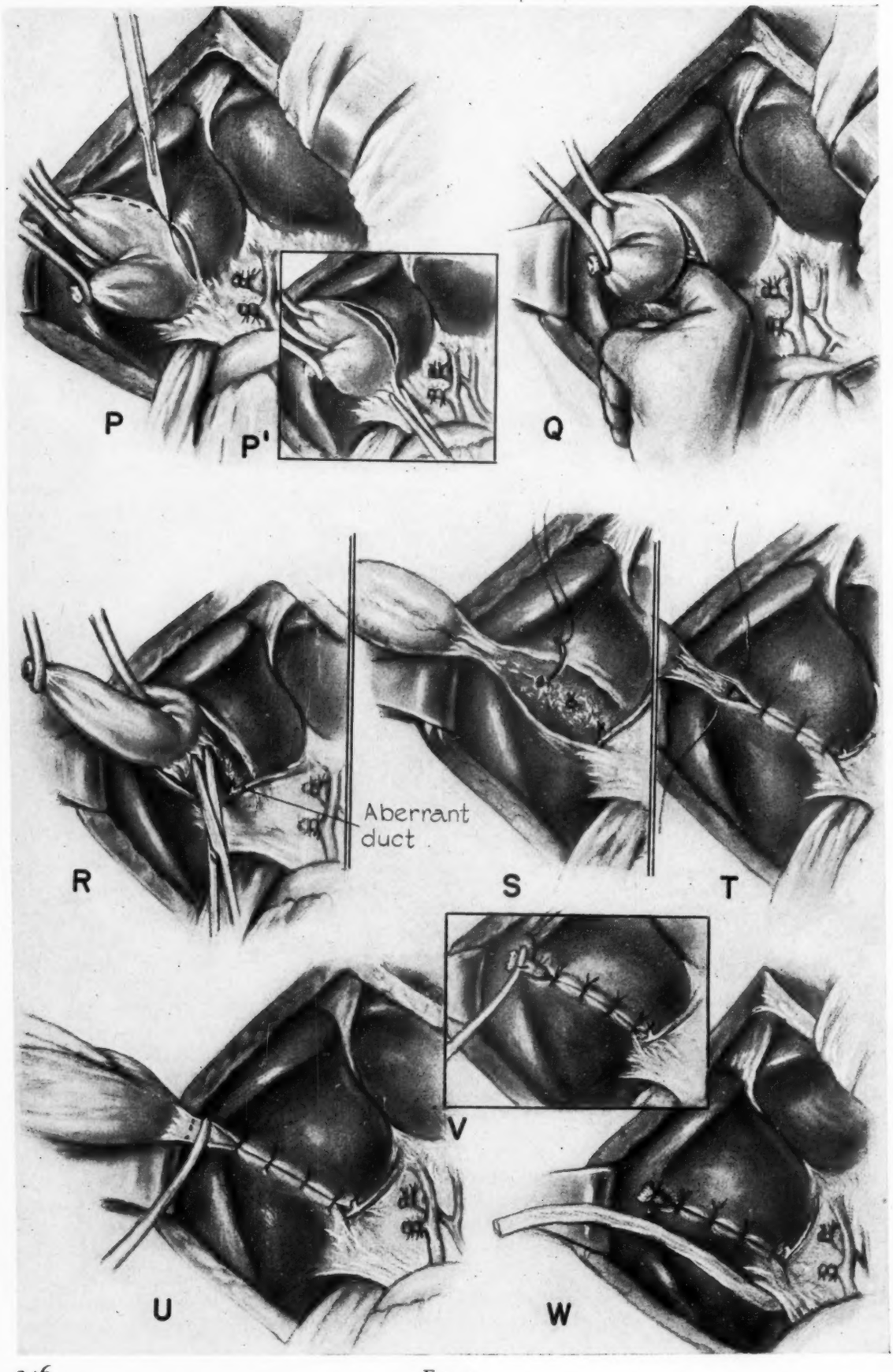

FIG. 3.

successful, progressively larger dilators are used, up to the size of 8 mm. Finally, a soft rubber catheter (No. 12F) is inserted, first proximally and then distally, and the lumen of the duct is thoroughly irrigated with copious quantities of warm saline solution. (Fig. 7I.) The presence of the catheter in the lumen of the duodenum, when irrigating, is indicated by the absence of regurgitant fluid and the concomitant distention of the duodenum.

Following the completion of the exploration, a catheter (No. 12F), with one terminal and one side opening at its tip, is inserted into the lumen of the common duct in a proximal direction toward the liver. (Fig. 7J.) A catheter of this size is used regardless of the degree of dilatation of the common duct. Closure of the incision in the common duct is performed with interrupted sutures of No. 00000 arterial silk which are inserted from below upward. (Fig. 7J.) The catheter is not anchored by sutures to either the duct wall or skin. The gallbladder is then removed in the routine manner, as previously described, and the wound is drained. Both the drain and the catheter have their exit through the incision.

A cholangiogram is obtained routinely on the fourth postoperative day as a basis for potential future comparison, and if negative, the common duct catheter is immediately removed. The drain is removed on the seventh postoperative day.

COMMENTS

In operations upon the gallbladder and biliary tract, one must always be cognizant of the frequent anomalies of the bile ducts and their related structures. The frequency of the anomalies is such as to make the phrase "simple cholecystectomy" illogical. In fact, in performing cholecystectomy one should consider the anatomy abnormal until proved otherwise. Unfortunately, it is in the "simple cholecystectomy" that many of the injuries to the common duct occur.

In the performance of cholecystectomy, the gallbladder may be removed either from above downward, or in a retrograde manner from below upward. Although generally, the choice of operation is dependent upon the preference of the surgeon, one should be familiar with both methods since in some instances, particularly in the acute stage, removal from above downward may be mandatory. In this regard it should be emphasized that under some circumstances cholecystostomy may prove to be the procedure of choice. It is an operation for which an apology is not necessary and one that a surgeon should never feel too proud to perform. Its judicious use may save a patient's life.

An important technical factor in the prevention of injury to either the common duct or the right hepatic artery is the dissection and individual isolation of the cystic duct and the cystic artery, respectively. This is done before either structure is clamped or ligated. The dissection of the cystic duct is continued until its junction with the common hepatic duct to form the common bile duct is demonstrated. In this way one may avoid leaving a long cystic duct remnant and preclude the occurrence of a cystic duct syndrome.

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FIG. 3. P, similarly, as in Figure 2O, the peritoneal covering on the opposite side of the gallbladder is incised. P′ and Q, the mobilization of the gallbladder from its bed is begun by scissor and continued by blunt digital dissection. R, scissors are again used to complete the dissection of the gallbladder from the liver bed. An aberrant duct arising from the right hepatic duct at the porta hepatis may be seen passing across the lower portion of the gallbladder bed. A branch of the duct which entered the liver bed was inadvertently divided and required the application of a ligature as depicted. S, after its mobilization the gallbladder is allowed to lay on the surface of the abdomen for purpose of traction, and the liver bed is inspected for bleeding areas. The use of transfixion sutures of No. 000 silk for hemostasis is preferred to the various non-suture methods. T, U and V, the liver is peritonized and the vascular peritoneal attachment of the gallbladder to the liver is clamped, severed and occluded with a suture ligature of No. 000 silk. W, a portion of a Penrose (cigarette) drain is inserted into the foramen of Winslow and a layer closure of the wound completes the operation. The exit of the drain through the incision is preferred to the use of a stab wound.

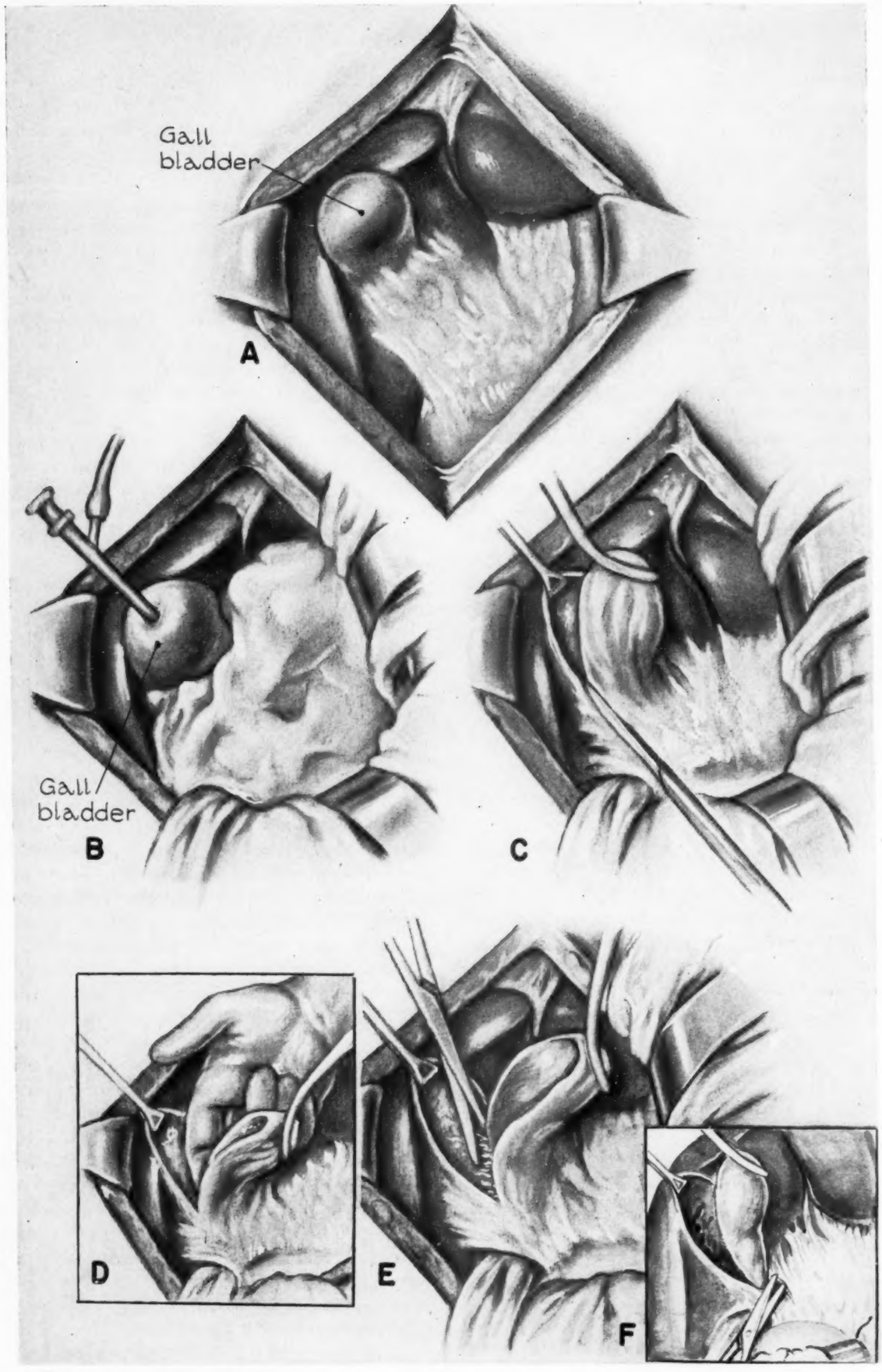

FIG. 4.

The cystic duct is never clamped until the common hepatic duct above and the common bile duct below are clearly visible. When clamps are applied to the cystic duct, they are placed neither too close nor too far away from the common duct. A sufficient length (4 to 6 mm.) of cystic duct is allowed to remain to permit closure with both a ligature and a transfixion suture ligature of No. 000 silk.

In the isolation of the cystic artery, its origin from the convex arch formed by the right hepatic artery (Figs. 1E, and 2N and I) is demonstrated routinely. When this is practiced, one may observe the frequent variations in the length of the cystic artery. In some instances it may be so short as to preclude the placement of two clamps. (Fig. 2M.) This finding causes one to wonder how often the right hepatic artery is ligated when the dissection and isolation technic is not performed. Ligation of the right hepatic artery may be indicated postoperatively by an unusually "stormy convalescence" or even a fatality. In secondary operations upon the biliary tract, atrophy of the right lobe of the liver is sometimes observed; this may also be evidence of an occluded right hepatic artery.

Although generally the right hepatic artery passes posterior to the common hepatic duct, it courses anteriorly (Fig. 2N) more often than expected. The decision of whether to ligate the cystic duct or the cystic artery first is dependent upon the particular findings in the individual patient. Usually it is the cystic duct. However, when the cystic artery is either anterior to the common duct (Fig. 2N), or shorter than the cystic duct (Fig. 2M), it is always ligated first. In the one instance it is a technical expediency and in the other it is a prophylaxis to the avulsion of a short cystic artery and resulting hemorrhage.

In explorations of the common duct, the gallbladder is left *in situ* as a technical aid and is removed after the completion of the exploration. However, the distal portion of the cystic duct is always ligated before exploration to prevent the egress of calculi from the gallbladder into the common duct. (Fig. 7E.)

TABLE I

INDICATIONS FOR EXPLORATION OF THE COMMON BILE DUCT

1. Jaundice, recent or present
2. Palpation of a stone
3. Roentgenographic visualization of a stone
4. Dilatation of the common bile duct
5. Aspiration of murky bile from the common duct
6. Multiple small stones in the gallbladder in conjunction with a dilated cystic duct
7. Thickened wall of common duct or induration of head of pancreas, or both
8. When in doubt

The indications for exploration of the common duct are listed in Table I. In the presence of one or more of these indications, the incidence of positive and negative explorations relative to the presence or absence of calculi is listed in Tables II and III. It may be of interest to note that in the series of negative explorations, the additional technical maneuver required did not effect an increase in either the morbidity or mortality rates.

In some instances of common duct exploration, either positive or negative, one is unable to insert a probe or a small dilator through the papilla into the duodenum. Under such circumstances, even though jaundice is absent, the burden of proof is on the surgeon to state that an obstruction is not present. In such instances

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FIG. 4. Cholecystectomy for acute cholecystitis. In the surgical management of patients with acute cholecystitis rigid individualization is practiced. Consequently, in some patients the gallbladder is removed in the acute stage, whereas in others cholecystectomy is performed as an elective procedure in a quiescent period at some later date. A, acute cholecystitis with distention of the gallbladder and surrounding inflammatory edema. B, the operative field is "walled off" with protective moist gauze pads and the gallbladder is decompressed, using a trocar and cannula. C, the opening in the fundus of the gallbladder is occluded with a curved (Kelly) clamp and the mobilization of the gallbladder from above downward by sharp dissection is begun. D and E, the detachment of the gallbladder from its bed is continued by blunt digital and scissor dissection. F, the scissor dissection is continued anteriorly in the edematous cholecystoduodenal ligament to expose the underlying cystic duct and artery.

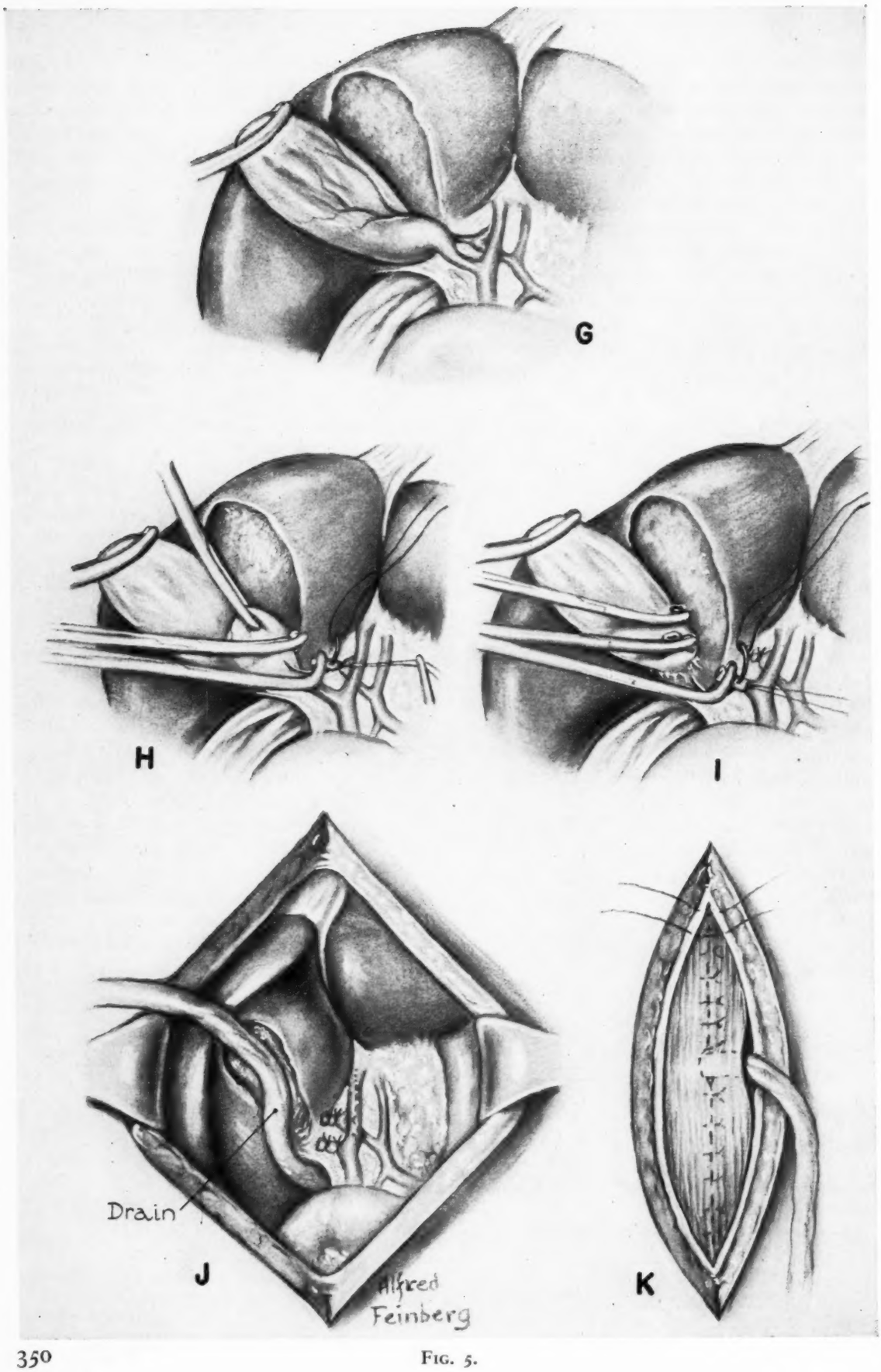

FIG. 5.

an immediate operative cholangiogram is of distinct value. If it is negative, nothing further need be done. However, if an obstruction is demonstrated, several procedures may be considered. Duodenotomy may be performed and the papilla of Vater inspected. If there is no evident cause for the obstruction, an attempt

TABLE II
CHOLECYSTECTOMY
AND
COMMON DUCT EXPLORATION

	Number	Deaths
Cholecystectomy	184	0
Cholecystectomy with common duct exploration	41 (22.3%)	0
(Exploration positive: 18 or 43.9%)		
(Exploration negative: 23 or 56.1%)		

TABLE III
COMMON DUCT EXPLORATION

	Number	Deaths	Mortality (%)
Common duct explorations	59	1	1.7
Primary explorations (41 cases, 69.5%):			
Positive	18 (43.9%)	0	0.0
Negative	23 (56.1%)	0	0.0
Secondary explorations (18 cases, 3.5%):			
Positive	13 (72.2%)	0	0.0
Negative	5 (27.8%)	1	20.0

at retrograde catheterization of the common duct is made. If this is unsuccessful and the presence of a tumor is excluded, one may either perform sphincterotomy or carry out side-to-side choledochoduodenostomy. We have practiced both methods and prefer the by-pass operation to division of the papilla and sphincter. In no instance have we observed a complicating cholangitis. Prior to our experience with this operation, the fear of such a complication was the deterring factor to its use. The postoperative roentgenograms (Fig. 8) have demonstrated free ingress and egress of the barium into the common duct and even its intrahepatic radicles without any associated clinical manifestations. None are expected, provided there is no stenosis of the anastomotic stoma. Although choledochoduodenostomy has been popular in Europe for many years, it is still conducive to controversy in this country.

Operative cholangiograms, although considered an important diagnostic aid, are not routinely obtained. Admittedly, despite the experience of the surgeon and the completeness of the exploration, stones in the common duct may escape detection. This fact is the basis for the axiom: "When exploration of the common duct is completed, the duct is again explored and the remaining stone or stones are removed." Contrariwise, however, despite the experience of the roentgenologist and the care with which the operative cholangiograms are performed, errors in interpretation with false positives and false negatives do occur. In general, operative cholangiograms are obtained if there is any doubt following a carefully performed exploration of the common duct. However, one cannot negate the value of routine operative cholangiography when stones in the common duct are demonstrated in patients in whom there are no clinical indications present to explore the common duct.

Upon completion of the exploration of the common duct, catheter drainage is routinely employed. A catheter is preferred to a T-tube, and a small one (No. 12F) is used regardless of the degree of dilatation of the common duct.

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FIG. 5. G, the mobilization of the gallbladder from its liver bed is completed. The only attachments remaining are the cystic duct and cystic artery. H, the cystic artery, because of its shorter length, is the first to be doubly clamped, severed and occluded distally with a ligature and a transfixion suture of No. 000 silk. I, in like manner the cystic duct is clamped, divided and occluded, and the gallbladder is removed. J, a drain is inserted routinely into the foramen of Winslow and has its exit through the wound. The open liver bed is preferred to the peritonization method previously illustrated. K, layer closure of the wound, using interrupted sutures of No. 00 silk for both the peritoneum and fascia. In the closure of a paramedian incision the rectus muscle serves as a protective barrier between the lines of closure in the peritoneal and fascial layers.

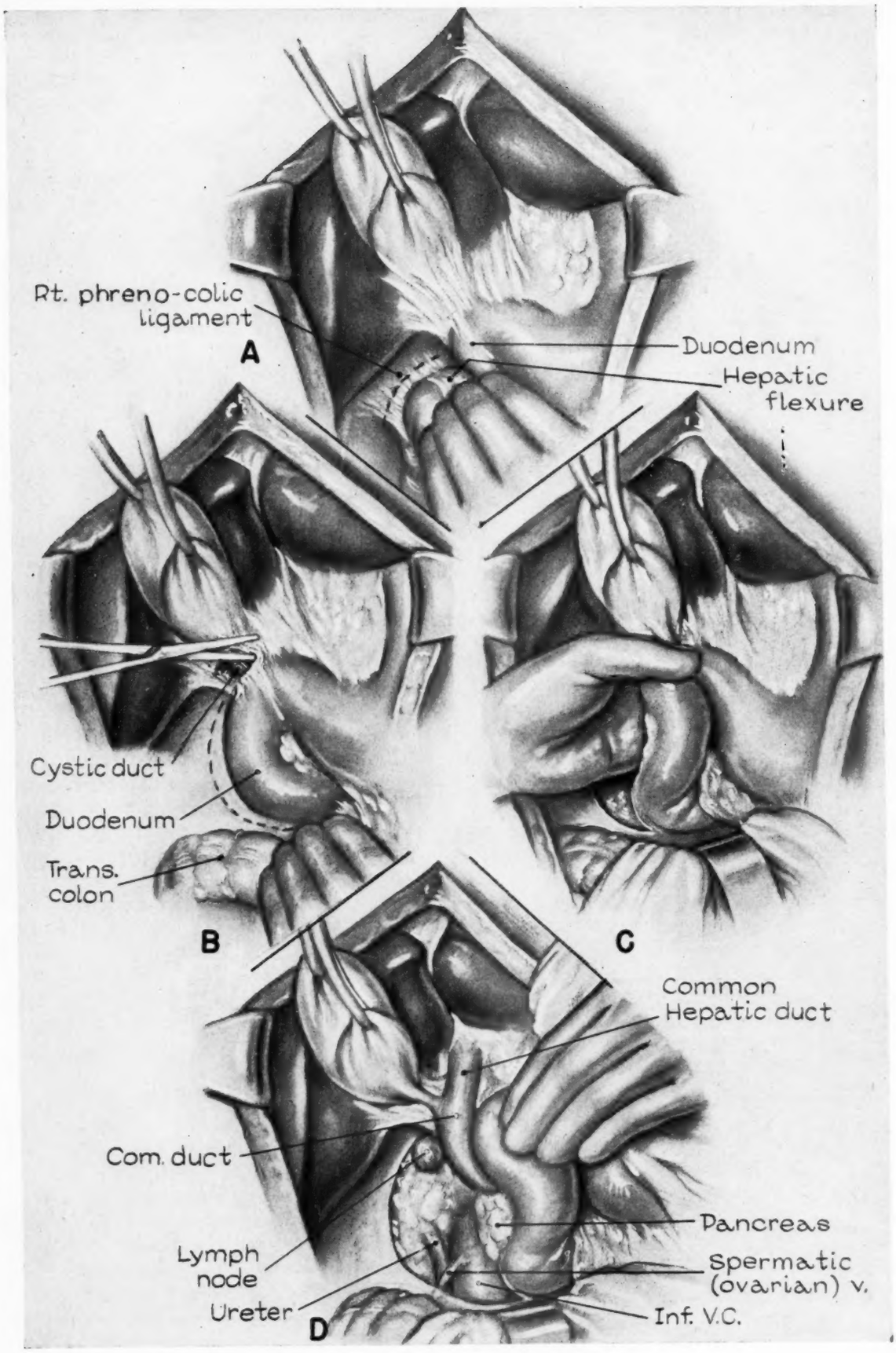
Rt. phreno-colic ligament
A
Duodenum
Hepatic flexure
Cystic duct
Duodenum
Trans. colon
B
C
Common Hepatic duct
Com. duct
Pancreas
Lymph node
Spermatic (ovarian) v.
Ureter
Inf. V.C.
D

FIG. 6.

FIG. 6. Common duct exploration. A, in all secondary explorations and frequently in primary explorations of the common duct, the hepatic flexure is mobilized by severance of the right phrenocolic ligament as depicted in dotted outline. B, the mobilized hepatic flexure and the proximal portion of the transverse colon are displaced downward and scissor dissection of the cholecystoduodenal ligament is begun. The curved dotted line indicates the line of incision (Kocher) in the posterior parietal peritoneum for the mobilization of the retrocolic portion of the duodenum. C, by blunt digital dissection in the retroperitoneal tissue plane the duodenum and the head of the pancreas are mobilized and rotated toward the midline. D, the mobilization of the second portion of the duodenum is completed to expose the retroduodenal portion of the common duct and its related structures. The lymph node shown laterally and the gastroduodenal artery medially are, as stressed by Cattell, excellent landmarks for the identification of the distal portion of the common duct.

See illustration on page 354.

FIG. 7. E, in explorations of the common duct, the gallbladder, because it serves as a technical expediency, is not removed until the exploration is completed. However, prior to exploration, the terminal portion of the cystic duct is occluded with a ligature of silk to prevent egress of stones from the gallbladder into the common duct. The incision in the anterior wall of the duct between Guy sutures of No. ooooo silk is shown in dotted outline. The location of the terminal portion of the common duct, between the lymph node laterally and the gastroduodenal artery medially, is visible. E′, a new set of Guy sutures is inserted through the incised margins of the common duct, and the Guy sutures in the wall of the duct are removed. F, the lumen of the dilated common duct is explored distally with a small scoop and a stone present is removed. G, digital palpation along the outside wall of the common duct against an indwelling probe is performed. This maneuver is a technical aid in the detection of small stones which may be felt to grate against the probe. H, the exploration of the common duct is continued with the use of a Bakes dilator (4 mm.). If possible, the dilator is inserted through the papilla of Vater into the duodenum. If successful, progressively larger dilators are used up to one of 8 mm. in size. In using the dilators one must avoid undue trauma or the establishment of false passages, or both. I, a soft rubber catheter (No. 12F) is inserted into the duct and irrigation of its lumen with copious quantities of warm saline solution is performed. This procedure is considered one of the best methods for the removal of occult stones. J, a two-holed rubber catheter (No. 12F) is inserted into the lumen of the common duct and directed toward the liver. This size catheter is used regardless of the degree of dilatation of the common duct and is removed routinely on the fourth postoperative day if the cholangiogram taken at this time is negative. Catheter drainage of the common duct is preferred to the use of a T-tube. K, the operative field after the completion of the exploration of the common duct, the establishment of a catheter choledochostomy and cholecystectomy.

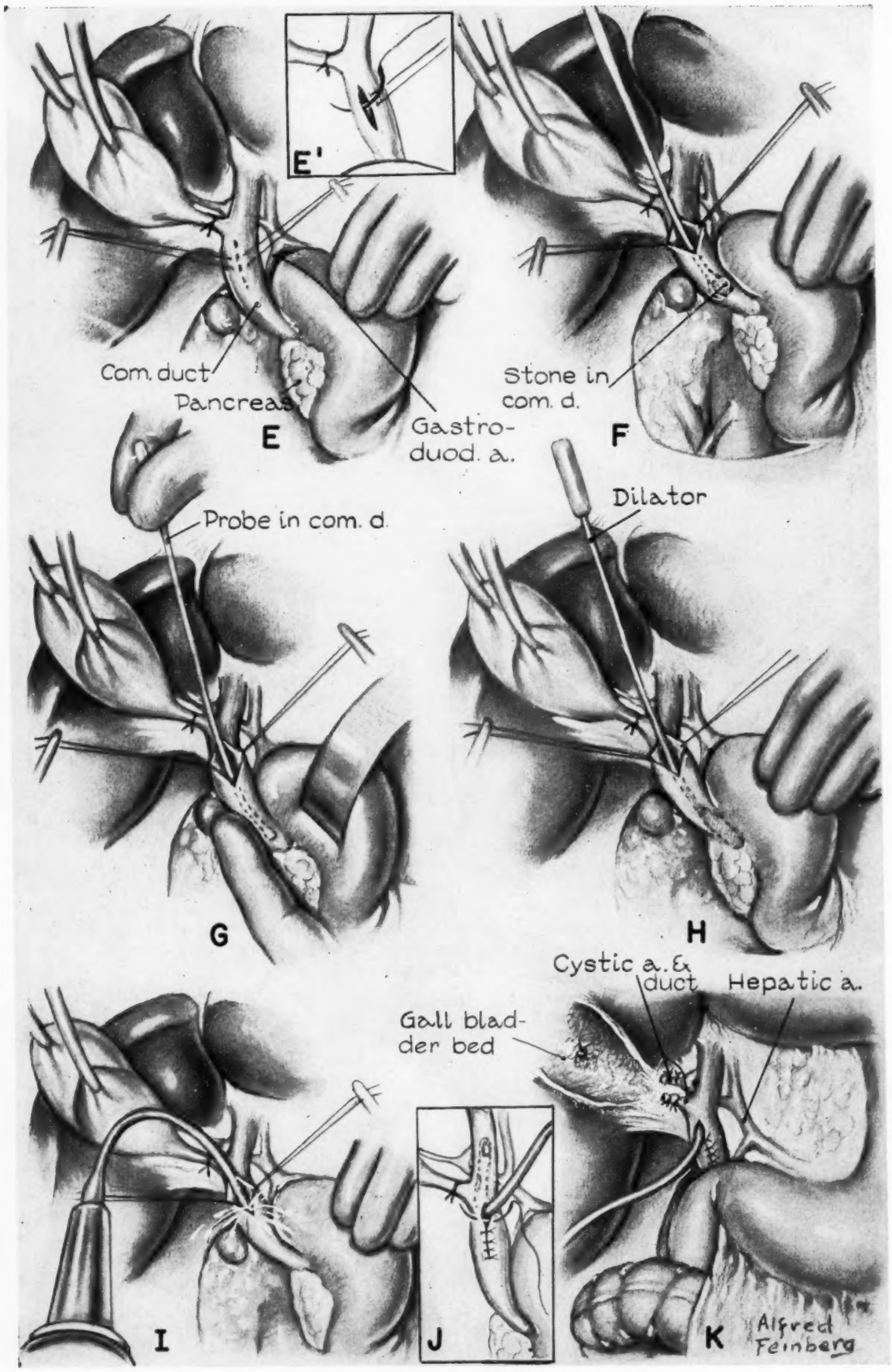

FIG. 7. See legend on page 353.

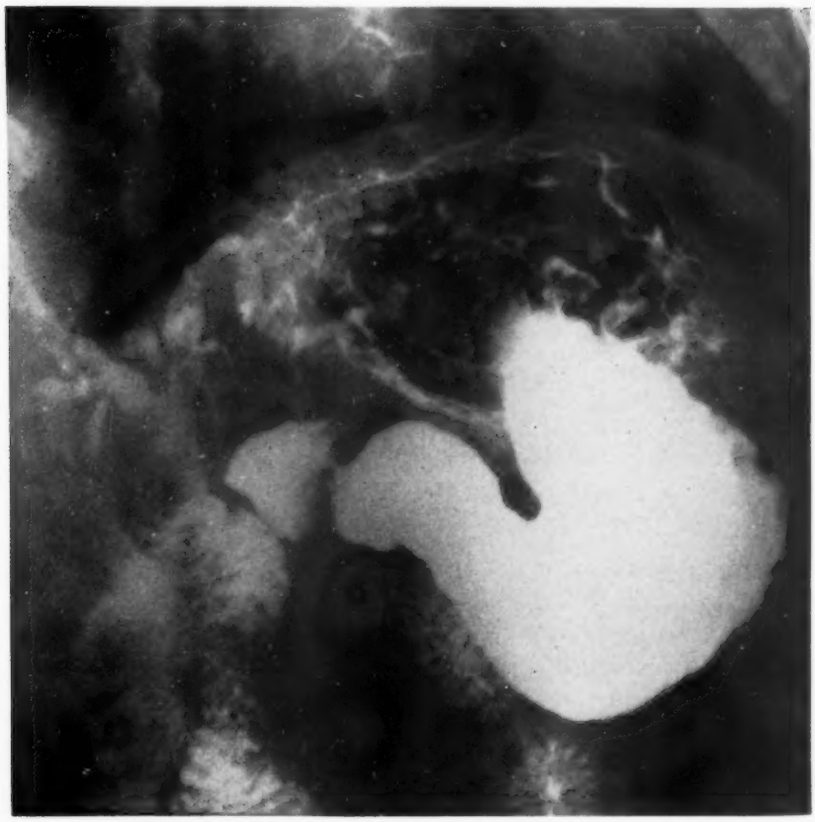

FIG. 8. Postoperative roentgenogram in an asymptomatic patient two years after choledochoduodenostomy, demonstrating the reflux of barium through the anastomotic stoma into the common duct and its intrahepatic radicles. It is not the reflux of gastrointestinal contents but stasis secondary to stenosis of the anastomosis that is believed to be the responsible factor for symptoms that may occur following choledochoduodenostomy.

Furthermore, it is believed that the time factor for tube drainage of the common duct is too arbitrary and in general too long. A catheter or T-tube is a foreign body which the tissues of the body inherently attempt to eject. Accordingly, the catheter is removed routinely on the fourth day and the Penrose (cigarette) drain on the seventh postoperative day. This routine has proved to be completely satisfactory.

Acknowledgment: Figures 1 to 7 from: "Atlas of Technics of Surgery" by John L. Madden, M.D. In preparation. Courtesy of Appleton-Century-Crofts, Inc.

Ventricular Fibrillation during Massive Blood Replacement

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VENTRICULAR fibrillation has been reported by Stephenson and co-workers[1] to have occurred in about 12 per cent of 1,200 cardiac arrests. A similar figure of 10 per cent was found by Leeds.[2] The present report describes nine cases of ventricular fibrillation which occurred during the course of radical abdominal operations associated with massive blood replacement.

CLINICAL EXPERIENCE

Nine instances of ventricular fibrillation, demonstrated by continuous electrocardiographic tracings, were found in a series of 253 patients who received 2,500 ml. or more of citrated blood during operation. Of these nine, six patients received over 5,000 ml. of blood prior to the development of ventricular fibrillation and the remaining three patients had received 3,500, 4,000 and 4,500 ml., respectively. In all but one patient there was no premonitory fall in blood pressure. Successful defibrillation by electrical shock was carried out in two of these patients. The following case report represents a typical example of the development of this complication.

CASE 1. J. A., a fifty-one year old white woman, was admitted for repair of a vesicovaginal fistula. Two years before she had undergone an uneventful hysterectomy and node dissection. Preoperative examination revealed a hemoglobin of 14.0 gm. per cent and a blood pressure of 150/90 mm. Hg. Induction was started at 10:30 A.M. with 250 mg. of thiopental followed by nitrous oxide, oxygen and ether. Within the first forty minutes of surgery there was a measured blood loss of 3,500 ml. By rapid blood replacement a satisfactory blood pressure and pulse were maintained until 11:27 A.M. when the blood pressure fell from 150/80 to 100/60 mm. Hg and then became imperceptible. At the same time the continuous electrocardiograph recording revealed ventricular fibrillation. (Fig. 1.) The chest was opened immediately and cardiac massage begun. Electrical defibrillation resulted in restoration of a spontaneous heartbeat at 11:35 A.M. At 11:50 A.M. the blood pressure was recorded at 130/80 mm. Hg and pulmonary edema developed which was treated by intravenous injection of 1.6 mg. of lanatoside C. One hour later, at the end of the surgical procedure, the blood pressure fell to 70/60 mm. Hg, with a pulse rate of 140 per minute. A drip of norepinephrine was started in the belief that adequate blood replacement had been accomplished. Since this form of therapy elicited a poor response, an additional 300 ml. of plasma and 500 ml. of blood were administered with a resultant rise in blood pressure to 120/80 mm. Hg and a fall in pulse rate to 100 per minute. After a stormy course complicated by pelvic operation this patient made a good recovery and was discharged from the hospital.

ETIOLOGY OF VENTRICULAR FIBRILLATION

The etiology of ventricular fibrillation complicating massive blood replacement is still undetermined although several causes have

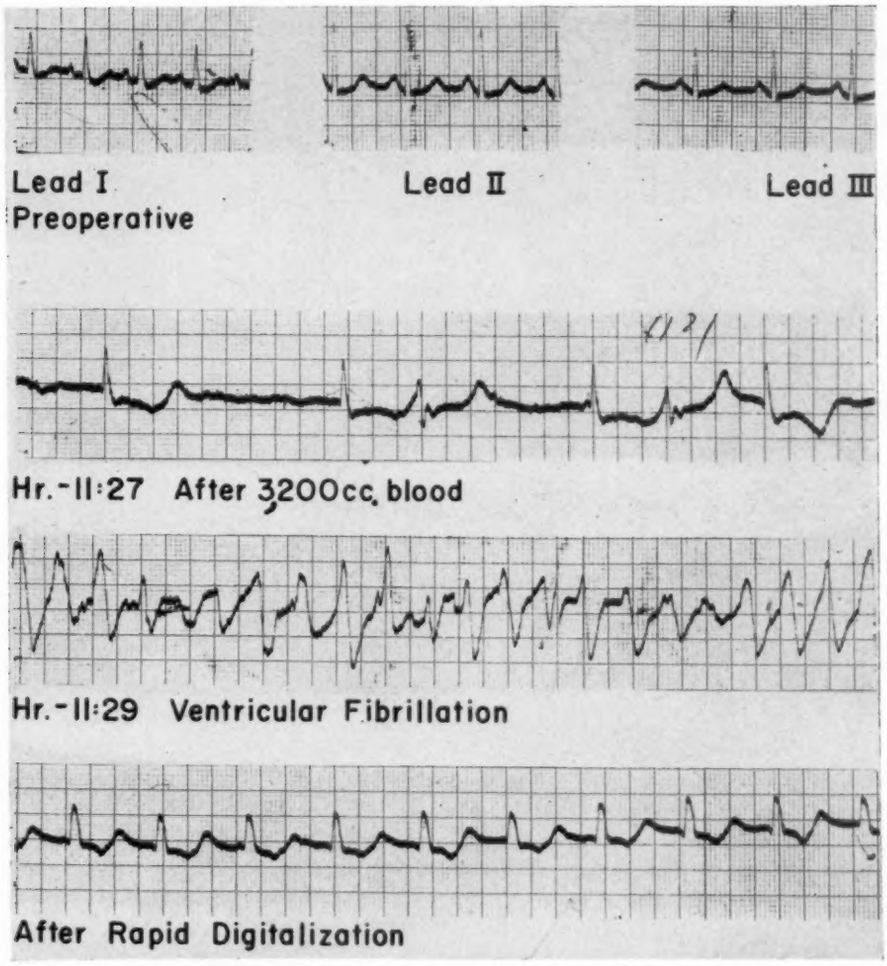

FIG. 1. Patient J. A. After 3,200 ml. of blood the patient exhibited ventricular tachycardia progressing to ventricular fibrillation. After defibrillation the electrocardiogram reverted to a more normal pattern.

been shown to have an important role in the development of this condition. DiPalma and Schults[3] in 1950 listed a series of factors which they felt were significant in precipitating the appearance of ventricular fibrillation. Included in this category were the rapid injection of potassium solution, a serum concentration of calcium higher than 30 mg. per cent and an increase in the hydrogen ion concentration of the blood with resultant hyperacidity. Deterling and co-workers[4] have demonstrated the occurrence of ventricular fibrillation during induced hypothermia.

In this series of ventricular fibrillation the most consistent finding was rapid intravenous citrated blood replacement. The majority of these patients received large quantities of blood over a short period of time. (Table 1.) In some instances the rapidity of administration was such that 500 ml. of blood were given in less than three minutes. The fact that ventricular fibrillation did not develop in other patients who received rapid massive blood replacement suggests that the speed of blood administration is not the sole factor responsible for the development of this complication.

Several authors have reported the dangers inherent in the administration of large quantities of citrated blood. Cookson et al.[5] believed that the removal of ionized calcium by combination with citrate produced an impairment of myocardial contraction and resulted in cardiac standstill in diastole. Bunker et al.[6] found a decrease in the calculated level of ionized calcium associated with elevated citric acid levels in the serum of a series of patients subjected to multiple rapid blood transfusions at the Massachusetts General Hospital. These

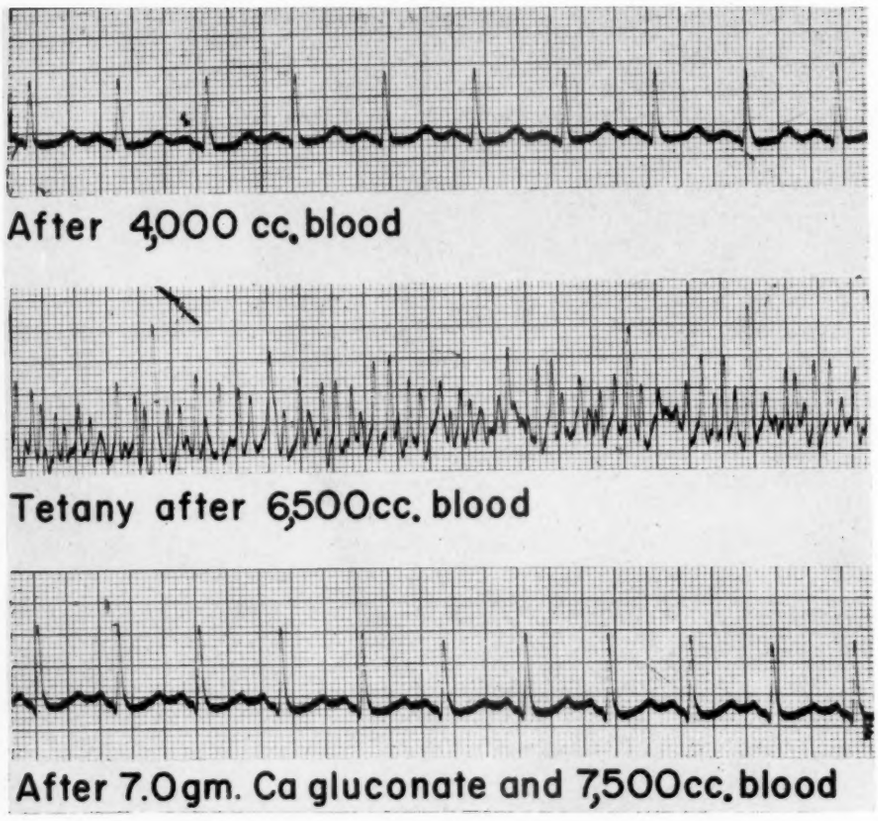

FIG. 2. Patient B. M. Line 2 shows the electrocardiographic manifestations of tetany which have reverted in the third line after appropriate treatment.

values were accentuated in individuals suffering from impaired hepatic function which is consistent with the role of the liver in the metabolism of citrate. The development of tetany in replacement transfusion in infants has been reported by Ames et al.[7] We have observed symptoms of tetany in a patient who received large amounts of citrated blood during an operation. These symptoms were corrected by the administration of calcium gluconate.

CASE II. B. M., a fifty-nine year old white woman, was admitted with a diagnosis of cancer of the cervix. Preoperative examination revealed a hemoglobin of 13.4 gm. and a blood pressure of 160/100 mm. Hg.

Marked loss of blood during the course of total pelvic exenteration necessitated the administration of 9,000 ml. of blood in two hours and fifteen minutes. The first 6,000 ml. were not covered by the intravenous injection of any calcium salt. Signs of tetany, at first on the electrocardiographic recording and later in the small muscles of the face, appeared during administration of the thirteenth pint of blood. (Fig. 2.) Fifteen hundred milliliters of dextran were substituted for the blood and a total of 6 gm. of calcium gluconate were given intravenously, with little or no change in the electrocardiogram. An additional 0.5 gm. of calcium gluconate was employed for each remaining pint of blood. The signs of tetany disappeared during administration of the fifteenth pint; the patient made an uneventful recovery.

This case supports the theory that the administration of large amounts of citrate decreases the level of ionized calcium in the plasma. Whether or not this deficiency of calcium has any effect on the development of ventricular fibrillation cannot be evaluated at the present time. It is interesting to note that the electrocardiographic signs seen prior to onset of ventricular fibrillation did not develop in this patient.

Stewart and co-workers[8] have demonstrated the role of hyperkalemia in the production of interventricular block and cardiac arrest in diastole. So far no definite evidence exists that an increased serum potassium level alone can lead to ventricular fibrillation in human beings. Crosby[9] has reported plasma potassium levels

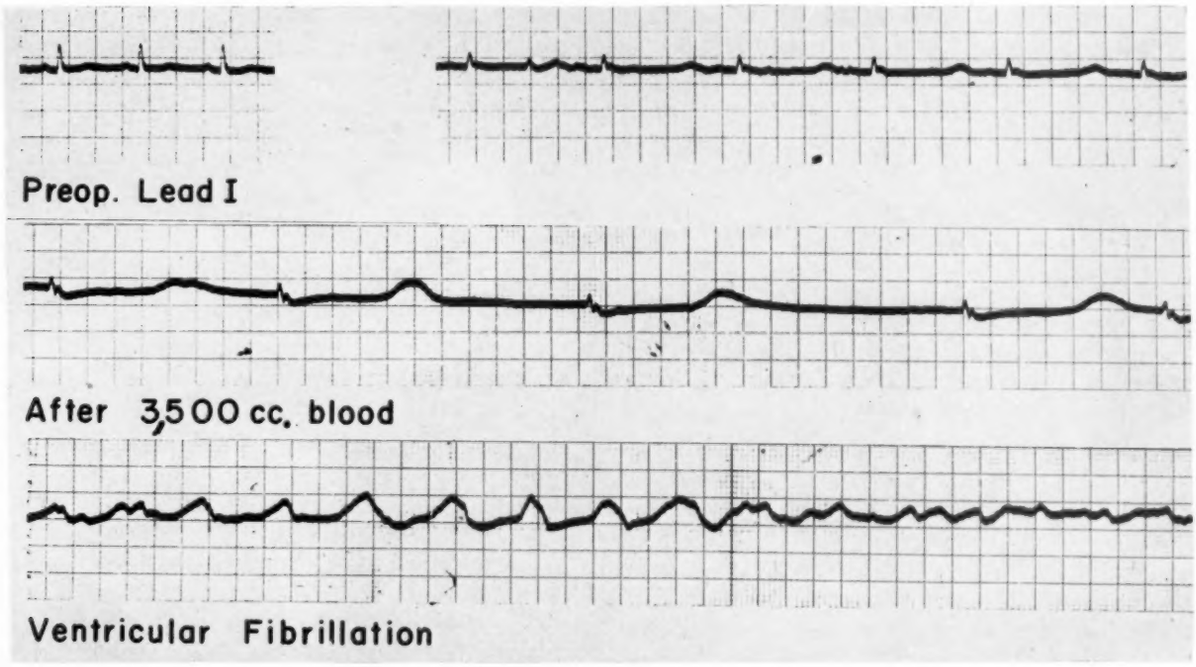

FIG. 3. Patient N. M.

as high as 15 mEq./L. in stored bank blood. However, in two patients in the present series, analysis of blood from the left ventricle at the time of cardiac massage revealed potassium levels of 6.15 and 5.85 mEq. values only slightly above normal. Many patients showing an equal elevation of serum potassium exhibit no evidence of ventricular fibrillation.

Although no data exist at present on the hydrogen ion concentration of the blood of patients who have received multiple rapid transfusions, it is known that the pH of stored bank blood is often in the vicinity of 6.8 to 6.9. This may be significant in view of DiPalma's observations on the role of lowered pH in the etiology of ventricular fibrillation.

In induced hypothermia the critical level for development of cardiac arrhythmias, including ventricular fibrillation, is 25°C.[10] In the blood bank, citrated blood is stored at a temperature below 4°C.

A sampling of twenty consecutive bottles of blood at the time of administration in the operating rooms of this hospital revealed temperatures between 4° and 10°C. Thus with rapid intravenous blood raplacement a direct stream of cold blood is delivered to the right heart. After several rapid transfusions there can be little opportunity for the warming of the blood in its passage to the heart. It is possible that this cooling of the myocardium may lead to cardiac arrhythmias and ventricular fibrillation.

TABLE 1
BLOOD ADMINISTRATION AT TIME OF VENTRICULAR FIBRILLATION

Patient	Total Blood and Duration of Replacement*	Blood Administered per Hour† (ml./hr.)
J. L.	8,500 ml./5 hr. (3,500 ml./20 min.)	10,500
B. J.	7,500 ml./3 hr. (5,000 ml./90 min.)	3,500
M. P.	6,500 ml./1 hr.	6,500
R. D.	9,500 ml./55 min.	10,000
M. N.	4,500 ml./40 min.	7,000
J. A.	3,500 ml./30 min.	7,000
S. B.	6,500 ml./2 hr.	3,250
B. M.	7,500 ml./3 hr.	2,500
L. A.	4,000 ml./1 hr.	4,000

* For patients J. L. and B. J. the figures in parentheses are the period of most rapid transfusion.

† All cases rated on an hourly basis.

PREVENTIVE FACTORS

Since the factors responsible for the production of ventricular fibrillation during the course of massive blood replacement are still conjectural, the measures which have thus far been undertaken to prevent the development of this complication are based on the theoretic premise that a decreased amount of calcium ion, hypo-

thermia and rapid citrated blood transfusions all play an etiologic role.

It has been our experience that use of a cardioscope in patients undergoing radical surgery and receiving large amounts of citrated blood offers considerable assistance in the diagnosis and therapy of ventricular fibrillation. Although there are no specific electrocardiographic changes premonitory of this complication which were seen in all cases, persistent elevation of the T wave should serve as a warning to exert caution in the administration of additional blood. Meroney[11] believes that an electrocardiogram showing peaking and elevation of the T waves, prolonged Q-T interval, and widening and disfigurement of the QRS complex is typical of potassium intoxication and hypocalcemia. Figure 3 shows this change in the electrocardiogram of a patient in whom ventricular fibrillation developed after rapid blood replacement. Prompt recognition of the appearance of ventricular fibrillation by means of the cardioscope facilitates the immediate initiation of appropriate therapy with cardiac massage and electrical defibrillation.

Failure to replace blood loss as it occurs may lead to circulatory collapse with the resultant necessity of administering large quantities of blood in a short period of time. Estimation of the blood loss by weighing sponges and measuring the volume in the suction bottle has proved of considerable value in maintaining adequate blood replacement during the course of major operative procedures. Venous pressure readings are an additional aid in evaluating the need for fluid replacement and in determining the rate at which blood can be safely administered.[12] A bottle of plasma volume expander may be given after every three or four bottles of blood to maintain the circulating fluid volume and simultaneously to reduce the danger of possible electrolyte imbalance due to transfusion of large volumes of citrated blood.

Although the administration of calcium gluconate or calcium chloride has proved to be of practical value in combating the decrease in calcium ions due to large amounts of citrate, it is difficult to estimate the exact quantity to be administered. The degree of ionization of these compounds varies considerably and the empiric injection of 1 gm. of calcium salt per 1,000 ml. of citrated blood may fail to effect its purpose or may lead to calcium overdose with possible deleterious effects on the myocardium.

In spite of the measures that have been discussed, the problem of prevention of ventricular fibrillation has not been solved. This complication remains a constant threat whenever large quantities of cold citrated blood are administered in a short period of time. Considerable investigative work must still be done before a final solution can be attained.

SUMMARY AND CONCLUSIONS

1. Of a series of 253 patients who received 2,500 ml. or more of citrated blood, ventricular fibrillation developed in nine patients.

2. Possible etiologic factors include the speed of blood replacement, decrease of ionized calcium in the blood, electrolyte changes, pH changes and lowered myocardial temperature.

3. The use of a continuously recording electrocardiogram, administration of calcium salts, the measurement of venous pressure and the replacement of blood as it is lost have all contributed to the prevention of ventricular fibrillation in more recent cases in this hospital.

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The Importance of Ground Substance in Surgical Concepts

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THE support function of connective tissue is evidenced by the action of bones, ligaments and fascia which shape and hold the body. The fact that connective tissue functions to defend the body should be emphasized. It has an amorphous material called ground substance which has recently been intensively studied. This material has been regarded as intercellular substance or matrix. Studies by Asboe-Hansen in Denmark, by Randall in England, and others in this country shed new light on the connective tissue system. Research studies on stress that followed Selye's investigations on pituitary and adrenal function have shown how the defense function is integrated for survival. The concept that the connective tissue is an active functioning system of the mesenchyme was previously enunciated by Bichat (a French physiologist) before 1800.

GROUND SUBSTANCE

It is shown that connective tissue consists of fibroblasts, fibers and ground substance. Clear spaces between fibroblasts seen in tissue microscopy have been attributed to tissue shrinkage in slide preparation. Since the ground substance is an amorphous hydrated gel present between cells, slide preparation would remove it; yet this component of tissue, varying in composition and volume, is active in physiology and pathology. The ground substance is a gel which varies in consistency from interstitial fluid to basement membrane and is coextensive with both. It is known to contain three mucopolysaccharides in the form of chondroitin sulphate, and hyaluronic acid. The jelly-like contents of a ganglion cyst represent a gross accumulation of ground substance, being largely hyaluronic acid. In a myxomatous tumor the amorphous ground substance content is in excess of the formed tissue. Wharton's jelly of the umbilical cord is largely ground substance. These facts are of interest in general surgery.

Improved postoperative care in surgery has resulted from studies in fluid and electrolyte balance. Such studies include the intravascular space and the intracellular space, and therapy is aimed at protecting the protoplasm in the intracellular space; yet from the vascular space, where parenteral therapy begins, the fluid and electrolyte goes through the interstitial space to reach the cell. Ground substance in the interstitial space responds to body changes in disease, injury and stress. In the adult the interstitial space is 12 per cent of body weight and the vascular space is 6 per cent, while the intracellular space is over 40 per cent. The interstitial volume in infants may reach 40 per cent of body weight. Ground substance is influenced by vitamins, hormones, steroids and protein products.

The relation between connective tissue and the blood system is shown in their common origin in the embryonic primitive mesenchyme. But connective tissue is in intimate relation also with the other types of tissue: nerve, muscle and epithelium. It provides the perineurium for nerves, the sarcolemma for muscle and the basement membrane for epithelium. Besides providing structural support for the tissue cells, it conveys nutrition from the circulation to the cells; and when the tissue cell is damaged by the stress of disease or injury the defense and repair is mediated through the connective tissue. It is the integrative mechanism which makes a mass of differentiated tissue an organism, and functions for support, nutrition and defense of the organism. The study of connective tissue function integrates the medical sciences into a unified system.

PAIN

Relief of pain has been the chief service of the physician. Effective therapy is based on diagnosis and treatment of the cause. When the diagnosis has been fully established, standard treatment exhaustively pursued and pain still exists, fuller knowledge of the latter becomes of practical importance. Pain may be a sensation or an emotion. The neural pathways associated with pain involve the thalamus, and palliative therapy for pain is largely concerned with strategic interruption of one of the pathways. Thus splanchnicectomy, rhizotomy, chordotomy (spinothalamic tract section) and frontal lobotomy may be resorted to for this purpose. Since any tissue stress that becomes a pain stimulus is mediated through an intact nervous system, neurosurgical palliation becomes desirable when specific therapy has failed. However, the site where the pain stimulus arises must be considered. It appears that except for epidermis the tissues responsible for pain are of mesodermic origin. The steroid hormones such as ACTH and cortisone have shown anesthetic properties, and a steroid useful as an anesthetic agent has also been developed. The effectiveness of cortisone and ACTH in the collagen diseases indicates that their action is on interstitial tissue. This suggests the importance of ground substance as the site of pain stimulus. The brain, liver or bowel can be incised under local anesthesia without a sensation of pain, and a pain stimulus is evoked when chemical changes occur in nearby connective tissue. Oxygen want in tissue is known to give rise to pain stimulus. This and the rate of tissue damage affect the intensity of the stimulus. It is not the seriousness or the amount of damage that causes pain. An increased excitatory state of the nervous system will affect the subjective sensation, yet the adaptive reactions to noxious stimulation may be so vigorous as to cause more damage and pain than the initial assault. Hypophysectomy and adrenalectomy apparently diminish the vigor of this over-reaction.

In abdominal surgery, under regional anesthesia, pain is felt when the tugging of tissue pulls on blood vessels; in brain surgery, under local anesthesia, pressure on the blood vessels also elicits pain. Distention on a viscus produces pain because it affects connective tissue. The pain stimulus is part of an alarm in the defense function of the connective tissue; it reveals to the consciousness that tissue destruction is in process. Minimal damage which is reversible remains below the pain threshold. If the rate of damage exceeds the rate of normal repair, pain is felt and inflammation begins. Inflammation itself aggravates the pain and contributes to defense. However, if not controlled, it may be destructive to nearby structures. Retaining the reparative effects of inflammation shorn of untoward influences is an objective of present steroid therapy.

The condition that produces a pain constitutes a stress and initiates a defense response characteristic of the adaptation syndrome as described by Selye. Tissue stresses that end in pain result in chemical changes in the ground substance. Stress frequently causes local alteration in calcium metabolism and results in precipitation of calcium. This is evident in calcified supraspinatus tendon, pancreatitis and calcified fibromyoma. Supraspinatus syndrome, radiohumeral bursitis and Quervain's disease (stenosing tendonitis) illustrate painful connective tissue conditions at the shoulder, elbow and wrist. They result from overactivity and represent a metabolic overload of the local tissue. Pain in the shoulder is treated by irradiation, ultrasonics, diathermy, injection of novocain® and hydrocortone® and exploratory incision. Any of these methods may be equally effective; it appears that they alter the local tissue response to stress. This is also true of appropriate incision at the elbow or shoulder, and the frequent dramatic relief, not explainable by the mechanical change accomplished, appears to result from local tissue metabolism alteration.

PATHOLOGIC CALCIFICATION

Ground substance is related to interstitial calcification. The plaques of calcium salts deposited in ground substance was described by Randall, and Baker noted that such calcium deposits in the ground substance of the renal medulla led to the formation of urinary calculi. Calculi in the biliary tract and the milk of calcium gallbladder result from a break-down of the interstitial tissue. The reticuloendothelial system of the liver is part of the connective tissue system, and during a portion of fetal life the liver is an important blood-forming organ.

Acute pancreatitis has not been fully understood and the calcification of the chronic re-

lapsing type opens speculation as to whether ground substance breakdown occurs. Clinical evidence that irradiation and ACTH and cortisone give relief in this entity suggest that the major pathologic condition is in the interstitial tissue of the pancreas.

INTRACARTILAGINOUS CALCIFICATION

Normal calcification of bone starts with an anlage of ground substance. The semi-fluid gel of bone anlage hardens to cartilage, and in time calcium is laid down in this matrix followed by osteogenesis. Bone is formed showing osteocytes, lacunas or spaces, Haversian canals about the blood vessels, and typical calcification. The calcium salt is laid down as a phosphate called apatite which has a characteristic crystalline structure. In pathologic calcium deposits the same salt is precipitated, so that microscopically such deposits may be taken for bone. It appears that all calcification is caused by alteration of connective tissue in the area involved, whether it be connected with injury such as ossifying hematoma or myositis ossificans, or with collagen disease such as the calcinosis of scleroderma, or tumor degeneration such as calcified fibromyoma, or with irradiation therapy.

CALCIUM METABOLISM

The main depot for calcium supply is in the bones: the skeleton contains 1,200 gm. of calcium. A balance is maintained between the bones and other tissues by ingestion and excretion of calcium and by the action of various hormones and vitamins. The calcium compartment of the body is in the interstitial space and blood plasma, with 280 mg. in the circulating plasma, half of which is in ionized form. The interstitial space contains 500 mg. of calcium, nearly all in ionized form. All the calcium in the interstitial space may exchange with the bones in one minute. There is practically no calcium in the intracellular space.

Because calcium is precipitated as phosphate, phosphorous is involved in calcium metabolism. If the concentration of calcium and phosphorus in the blood is such that the product of their values exceeds 40, the "product of solubility" has been exceeded and abnormal precipitation may occur. The blood calcium should not exceed 10 mg.; if it does, the blood phosphorus will drop below 4 mg. Calcium precipitation is quickly evident in urine formation. Urine is formed by altering the composition of the glomerular filtrate as it passes up and down the proximal and distal convoluted tubules. A supersaturated solution of calcium salts may form. The ground substance surrounding the tubule cells aids in this process. A small fraction of ground substance enters the urine as chondroitin sulphuric acid to maintain insoluble calcium salts in suspension, and acts as a "protective colloid" against precipitation and calculi formation. When the system breaks down, calcium deposits in the lumen and becomes the matrix for calculus formation by further precipitation of calcium on the core of the original deposit. Renal calculi and calcification have resulted from excess parathormone in parathyroid adenoma, excess ingestion of vitamin D and a drug formerly used for treating obesity.

The defensive function of the connective tissue system is coordinated by the pituitary and adrenal glands. Selye's experimental animals were able to survive sublethal injections of tissue extracts, but if either the pituitary or the adrenals were removed a similar injection resulted in death of the animal. In the intact animal the shock of injection was followed by a countershock phase coordinated by glandular hormones. Mineral or electrolyte metabolism and protein and carbohydrate metabolism are altered by corticosteroids secreted in the posttraumatic state. The possible untoward effects of steroid therapy is a new factor in standard practice.

CORTICOADRENAL ATROPHY

Persons with diabetes carry identification cards, and a similar plan may be necessary for patients taking cortisone. Administration of this drug is followed by adrenal cortex atrophy, and a person who is injured when his adrenal cortex is in a state of drug-induced atrophy might go into shock because of inability to accomplish the countershock phase. He would need help in the form of intravenous hydrocortone drip. However, the use of ACTH at the end of a course of cortisone would overcome this atrophy.

GROUND SUBSTANCE VARIATIONS

Corticosteroids influence ground substance; some speed the flow of materials through ground substance, others slow down the flow. Other hormones such as thyroid also affect ground substance. In myxedema a shift in

chemical composition of ground substance toward chondroitin sulphate has been demonstrated. In thyroidectomized guinea pigs, administration of thyroid hormone leads to exophthalmos, and this is shown to result from increase of the ground substance in the retrobulbar tissues.

Fibroblasts together with ground substance are responsible for the formation of collagen fibers in repair. The abundance of ground substance in the tissues of the young explains why inflammation in pediatric surgery is accompanied by more swelling than in the adult. Conversely, the scant amount of ground substance in aged tissue leads to speculation as to whether hormonal stimulation to increase ground substance would diminish the aging process. The effectiveness of androgen-estrogen hormone in senility problems suggests that aging is controllable to some degree. The potent effect of these hormones in the treatment of cancer of the breast and the paradoxic improvement following adrenalectomy or hypophysectomy is of special interest.

LABORIT'S LYTIC "COCKTAIL"

The success of adrenalectomy in incurable cancer implies that a futile defense is less beneficial than no defense. The alarm reaction is helpful in stress, yet diminishing this reaction to advantage is apparently the basis for Laborit's lytic cocktail. Laborit, a French surgeon, devised a method for the treatment of shock which was used in the recent Indochinese War. His mixture consisted of three drugs; a neuroplegic (thorazine), an antihistamine (phenergan®) and an analgesic (demerol®). When given parenterally, this mixture produced hibernation. The body temperature fell, the pulse rate dropped and the sensorium changed. With the body's natural alarm reaction nullified, appropriate parenteral and inhalation therapy was given. On this continent greater emphasis has been placed on hypothermia for high risk surgery in cardiac cases. In Europe, where artificial hibernation is used preceding hypothermia, it is possible that untoward results of refrigeration itself are mitigated. In therapy, modern anesthetic technics can take charge of the vital processes when reflex controls are disconnected. The coma and body cooling of shock is imitated in the practice of artificial hibernation and hypothermia. Experiments with animals having generalized body injury, and using temperature control, showed that the survival rate was highest in those with skin temperature of 72°F., the lowest rate at 98°F., and the median value obtained for the 40°F. group. Body cooling to room temperature is advantageous in injury.

MULTIPLE INJURY AND SHOCK

Serious multiple injury occurs in automobile accidents as well as in war. The problem of shock arises. An overzealous surgical attack on injury to both trunk and extremities sometimes results fatally. Adequate supplies of blood do not solve all shock problems, for shock may become irreversible in spite of this. Shock teams in Korea learned that with wounds of the trunk hemoconcentration developed, and with wounds of the extremity hemodilution occurred. Physiologists have shown that the lymph fluid of the extremities has a low protein content, while visceral lymph fluid has a high protein content. Surgeons of a nation recently engaged in military operations obtained improved results by refrigerating injured extremities and treating injuries to the trunk first. Establishing such a practice of treatment in stages for multiple injury allows the general surgeon and urologist to attack urgent problems first; then the orthopedist can begin as soon as the patient is better fitted for survival.

A NEW THEORY OF SHOCK

A theory of shock recently described by Shorr shows the importance of the perivascular connective tissue in this process. The blood pressure fall in shock, which lessens venous return to the heart, lessens the chance of bleeding in the wounded or injured organism. It may jeopardize some vital processes but it enforces immobilization which contributes to survival. A mass migration of circulating fluid from the vascular space to the interstitial space occurs, and is held there by ground substance until it is returned to the circulation when the countershock phase begins. The chemical stimulus to shock arises from injured tissue as well as rapidly secreted adrenal hormones which increase the response. Shock is a physiologic mechanism for survival, and is lethal only when prolonged or excessive. Similarly, excessive dosage of beneficial medications is also lethal. While shock has usually been treated by counteracting it, methods of shock treatment such as artificial hibernation act by

subduing the shock process and controlling the "dosage."

The connective tissue link with blood vessels is evident by reviewing phylogeny or evolution. In the most primitive animals an intercellular substance serves for transport between cells. In higher animals blood plasma enclosed in the circulation space is more fluid than the gel-like intercellular substance, and when propelled by the heart is an efficient transport medium. The intravascular space is a specialized one; for example, the red blood cell normally enters it from the bone marrow after it has lost its nucleus, and leaves the circulation space at the end of its span to be taken up by the spleen. The plasma and red cells accomplish oxygen transport, and the white cells are involved in body defense. The connective tissue relation is shown in that many defensive white blood cells are also found in the interstitial space. The development of shock after injury seems to be a defense tactic of the organism to prevent exsanguination. The interstitial tissue absorbs the blood plasma until the clotting and countershock mechanisms develop, when the circulatory volume and pressure are restored to support the vital processes of tissue oxidation. The oxygen-carrying red cell can again function when fluid returns to the circulation space and flows with its accustomed force.

Clinical application of shock-like states is shown in anesthesia. Curare disconnects one physiologic mechanism to avoid an undesirable response during surgery. Also, controlled hypotension nullifies certain reflexes and produces a status favorable for surgery. Control of the complex natural defensive mechanism is also evidenced by the anti-inflammatory effect of steroids.

CYBERNETICS OR FEEDBACK

The pituitary and the adrenal glands show a feedback mechanism which is well integrated for function. The pituitary secretes adrenocorticotropic hormone which stimulates the adrenal cortex to produce its hormones, including cortisone. Cortisone entering the circulation affects the pituitary as an inhibitor and the secretion of ACTH is lessened. This hormonal relationship constitutes a chemical "feedback," a responsive inter-relationship which results in a balanced action between the two. Another feedback mechanism is shown by the level of circulating calcium and parathormone. A low serum calcium stimulates the parathyroid which secretes more hormone to mobilize calcium from the bones.

COLLAGEN DISEASES

Cortisone and other steroids find clinical application in rheumatoid arthritis and other collagen diseases such as rheumatic fever, generalized lupus erythematosus, periarteritis nodosa, dermatomyositis and scleroderma. In these conditions changes occur in connective tissue; in scleroderma subcutaneous calcification is often present. Research in rheumatism helps reveal the nature of ground substance. Tissue cultures of mesenchyme show the varying composition of ground substance in health and disease.

HYALURONIDASE

Improved therapy has resulted from varying the composition of ground substance. One component of ground substance is hyaluronic acid. The enzyme hyaluronidase degrades hyaluronic acid making it less gel-like and more fluid. This enzyme added to hypodermoclysis fluid in pediatric practice assists in rapid absorption. By making ground substance less viscous, additional fluid combines with it more readily, replenishing the interstitial space to overcome dehydration.

Hyaluronidase is also effective in painful sprain which is a connective tissue stress. Pain in a sprained ankle has been treated by immobilization and support, yet it has often been difficult to enforce immobilization for an injury which gives a negative result on x-ray. The effectiveness of novocain injection beyond the duration of anesthesia is said to result from the blocking reflex vasospasm mediated through the sympathetic nervous system. Generally the response to a noxious stimulus aggravates the condition of the tissue in which the stimulus arises. An example of a pain condition closely related to a sprained ankle is Sudeck's atrophy. Here, injury to an extremity without fracture results in localized decalcification of bone. This is an association of pain, disordered calcium metabolism, connective tissue and stress, a significant combination. Calcium is the predominant ion of the interstitial space, just as sodium is predominant in the vascular space and potassium in the intracellular space. The interstitial area appears to be the area of forma-

tion of pain stimulus, tissue repair and body defense. Altering the connective tissue response to injury with steroids has become modern therapy.

Hydrocortone injected locally has been used in cases of painful shoulder and tennis elbow. The new use of procaine, hydrocortone and hyaluronidase combined for certain conditions such as chronic sprain has been quite effective. Pain and spasm are relieved, motion restored and disability overcome.

Altering the connective tissue response by the use of hyaluronidase is resorted to in the treatment of Volkmann's contracture. This calamity after fracture about the elbow is known to result from compression and venostasis. The possible mechanism may be damage to interstitial tissue so that it may no longer support the muscle cells, which then become atrophied. Hyaluronidase alters the ground substance which facilitates natural repair processes.

CLINICAL ALTERATION OF METABOLISM

Altering the response to injury by cold compresses in sprains has been standard practice. Better results are thus obtained by inhibiting the inflammatory response. Laborit's lytic cocktail to produce hibernation also applies this principle acting on the entire organism as cold compresses do locally. Adrenalectomy for cancer seems to follow this principle.

Medical research today is directed at chemical changes attending disease. An intensive program of study is in progress to discover chemical agents useful in cancer therapy. A mixture of calcium, vitamins and antibiotics is found to accelerate wound and bone healing in the treatment of injury. Antibiotics may have more than an antibacterial effect in physiology; terramycin® added to the diets of domestic animals produces larger animals more quickly.

The pathology that follows malnutrition may resemble infection; pellagra was once considered to be an infectious process. A condition of painful burning feet seen in prisoner of war camps has been labeled "nutritional melalgia." It is believed to be a pantothenic acid deficiency and apparently involves the walls of blood vessels. A similar entity has been described in cases of rheumatoid arthritis, and painful burning feet is known to occur in diabetes. These conditions are susceptible to relapse, so one may assume that irreversible changes have occurred. Since blood vessels are specialized connective tissue organs, this may be regarded as connective tissue pathology.

GLOBULIN AND HEPARIN

The antibody-bearing gamma globulins which defend against infection are elaborated by plasma cells in the interstitial space to enter the plasma in the circulation space. Blood clotting factors must be elaborated in the extracirculatory or interstitial space and join with the circulation or blood elements when the integrity of the circulation space is broken and bleeding begins. Intravascular clotting may result from endothelial or vasa vasorum damage. Thromboembolic disease that follows postoperative hemostasis in leg veins results from an excess of clotting factors in the circulation. Of the anticoagulant medications used for therapy, heparin has remained in continued high repute; other anticoagulants such as dicumarol having been discarded by de Takats and others. Heparin inhibits blood clotting and also inhibits alteration of ground substance by hyaluronidase; it is an enzyme inhibitor. Relief of pain with heparin in thrombophlebitis may be from its effect on connective tissue. This is plausible because another drug, butazolidin,® which is known as a connective tissue alterative, is equally effective in relieving pain in thrombophlebitis. Butazolidin is chiefly an antiarthritic drug, but research studies in arthritis have led to a better knowledge of ground substance and connective tissue.

THERAPY

Painful degenerative processes have been labeled "rheumatism" from the aspirin to the cortisone era. Physiotherapy used for rheumatism has been for alteration of connective tissue. Estrogen-androgen hormone and vitamin C in elderly patients with chronic sprain has been effective, showing that hormone and vitamin as well may influence connective tissue clinically.

Vitamin C is necessary to prevent postoperative dehiscence of surgical wounds in elderly patients. It is used by fibroblasts and ground substance to form collagen fibers. The chemical structural formula of ascorbic acid and adrenalin are similar in that they both have five-membered rings. Vitamin C deficiency affects blood clotting; the hemorrhage of scurvy may thus result, or it may come from capillary

fragility because of poor quality ground substance or intercellular matrix.

TISSUE REPAIR, SCARS AND CALCIFICATION

The capillary loop and fibroblasts are associated in tissue repair, and may require governing by the clinician. Healing of a skin incision may result in keloid or hypertrophied scar. Excision followed by irradiation is sometimes necessary to deal with this problem. Cortisone has been used to curb the exuberance of fibroblastic proliferation which results in hypertrophied scar. Increasing applicability of the steroids may standardize the control of the defensive process of repair by connective tissue to effect desired results in plastic surgery.

An untoward condition in tissue repair is evidenced by interstitial calcification. A Southern surgeon reported osseous calcification in six patients with upper abdominal wounds. The average age of this group was over fifty. The changes in calcium metabolism that make the difference between keeping calcium in solution and precipitating are subtle. In ground substance the binding amino acid radicals of the mucopolysaccharide are detached and depolymerization occurs. Breaking down ground substance may cause a loss of the protective colloid effect. This may be an intermediate step in calcium precipitation. Altered metabolism of calcium which leads to calcification is caused by local tissue conditions.

CALCIUM METABOLISM ALTERATION

Calcium in bone strengthens it, and the bone also serves as a storehouse. Motion of living tissue moves calcium in and out of the bony depot daily. Total body immobilization, as in recumbent paraplegics, leads to osteoporosis and finally to urinary calculi. On the other hand, excess deposits of calcium in clubbed fingers and toes develop in hypertrophic pulmonary osteoarthropathy. Oxygen deficiency plus lower body temperature at the extremities may lead to excess deposition of calcium in the normal bone depot. This may result from local breakdown of ground substance and loss of the protective colloid effect. Injured tissue releases the enzyme phosphatase which contributes to calcium deposition, which also may be a factor in abnormal calcification. However, calcium metabolism has some apparent paradoxes.

For bone healing, immobilization predisposes to good bony union. When ossifying hematoma or myositis ossificans threaten, immobilization prevents calcium deposition. Localized immobilization therefore favors physiologic repair of injury. Roentgen irradiation for cancer may result in interstitial calcification, yet irradiation for a painful shoulder may result in dissolution of calcium deposit. In the patient with cancer there is destructive high dosage; the patient with pain in the shoulder receives stimulating low dosage. An apparent paradox of calcium metabolism is seen in experimental research. Baker found that a previously non-effective dose of parathyroid hormone caused calcification in the cartilage of mice when they were given toluidine blue; yet Miller found that toluidine blue prevented calcification in the cartilage of rats. It is to be noted that the experiment in mice was *in vivo* and had two variables, and the experiment in rats was *in vitro* and had one variable.

CALCIFICATION AND STRESS

Normal calcium deposition varies. In long bones, calcification is intracartilaginous; and in the skull, bone calcifies without the intervening formation of cartilage. In the water buffalo a crescent of calcium is normally laid down in the base of the heart, apparently providing for structural stresses that prevail there.

Pain and calcification often occur in the same areas but are not synchronous. Pain suggests pathology in process; calcification suggests a pathologic process completed. Calcification, whether it is pancreatic, subcutaneous or intratendinous, apparently occurs in the interstitial tissue. The disorders of calcium metabolism that lead to milk of calcium gallbladder or biliary calculi are defensive processes of connective tissue failing to remain within physiologic limits.

Altering the connective tissue metabolism has led to untoward results, as in the discarded drug treatment of obesity. The adipose tissue was shrunk but calcium deposits in the kidney also developed. A new drug known as a chelate and marketed under the name of versene is used in some hypercalcemia problems. The term chelate indicates a compound that unites with calcium to form a soluble salt. It has been used in some cases of lead poisoning in children since it also forms a soluble salt which is excreted by the kidneys. In adults it has led to some

untoward results from hypocalcemia and hemorrhage.

AREOLAR TISSUE, SHOCK AND TRAUMA

The formless areolar connective tissue seems like a mere padding to protect vital structures. Microscopic study of the areolar tissue near blood vessel, bone, tendon and skin reveals plasma, mast and wandering cells in addition to the fibroblasts, fibers and ground substance. While these tissues retain their gross primitive formlessness, the high regenerative capacity of primitive tissue is immediately elicited when the stress of injury or disease occurs. Whether hemorrhage control, bone healing, tendon repair or space filling (in healing by second or third intention) is the need, the connective tissue functions.

The phagocytic wandering cell clears the tissue wreckage, the plasma cell secretes the protective antibodies, and the mast cell engulfs the bacterial invaders. The circulating white cells of the blood provide ample mobile reenforcement called by the enzyme or hormone evolved by injury or stress. The padding of areolar tissue about blood vessels functions protectively for the blood stream.

Patients in shock and with multiple injuries who are treated without the many facilities of the modern hospital have shown creditable results after being given morphine for pain and "allowed to lie." In an evacuation hospital during World War II, the patients who came to the operating room later did better, suggesting that a time factor is advantageous in allowing the countershock phase to develop. While shock arising from bleeding, trauma and toxin may be differentiated, a distinction is also drawn between extremity and trunk injury. Pain of itself also intensifies shock: before the Thomas splint was used in World War I, fracture of the femur showed a 50 per cent mortality. This mechanism may resemble the collapse that results from an overdose of adrenalin.

COMMENTS

Pain in radiohumeral bursitis, in shoulder conditions and in the back and thigh (Ober's syndrome) are dramatically relieved by incision. Baker's reference to ground substance and renal calcification shows the need for detailed study of connective tissue in relation to surgical conditions. A new theory of shock seems plausible. As information increases, the integration of medical sciences becomes evident.

In addition to the support function of connective tissue, it also serves for nutrition and defense. Ground substance pervades throughout the interstitial space to nourish the body cell with material derived from the circulation. Areolar tissue surrounding blood vessels, tendons and other structures retains the primitive regenerative capacities needed for repair. Tissue repair is coordinated by neuroendocrine and enzymal factors which influence transport and assimilation of minerals, hormones and proteins.

The blood and circulation is a specialized connective tissue, its function supplemented by the functional capacity of other forms of connective tissue. Bleeding and clotting as well as pain and interstitial calcification are connective tissue processes. Shock appears as a defense tactic of the organism to prevent exsanguination. Homeostasis from the blending of defense processes fits the concept of the general adaptation syndrome of Selye.

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[A PHYSIOLOGIC PLASMA VOLUME EXPANDER. Plasma volume expanders have been adopted in surgical practice for rapid sustained restoration of blood volume. However, unlimited quantities may not be used and the deposit of some of these substances in human tissues could ultimately have untoward results. Expanders for use in mass casualties make defense needs a continuing stimulus for the improvement of such materials. The effectiveness of these substances (dextran, polyvinylpyridine, and gelatin) depends upon the size of their molecules.

It is possible that a hydrated gel could be manufactured, which actually would be similar to the intercellular substance. Wharton's jelly (umbilical cord) or the contents of a ganglion cyst are all normally occurring gels which resemble the natural ground substance that pervades throughout the connective tissue. Ground substance is known to be a combination of various mucopolysaccharides, including hyaluronic acid and chondroitin sulphate. If a hydrated gel for intravenous use could be made of such materials, would this not then be a physiologic plasma volume expander and form a normal part of the body composition as readily as does the sodium chloride of physiologic solution of saline?]

Vascular Changes and Clinical Results Obtained with the Solution of Benzyl Cinnamate with Vitamin A in Arteriosclerotic Lesions

A PRELIMINARY REPORT

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THE biologic properties of the solution of benzyl cinnamate and vitamin A, and the rationale of its application in arteriosclerotic lesions have been discussed in previous publications.[1,2]

The vascular changes which resulted from the injection of this preparation were studied on arteriosclerotic lesions of the retina where the ophthalmoscope offers the advantage of direct observation of the changes in the vessels. These vascular changes are characterized: (1) by formation of new vessels, (2) by changes in the pathology of the arteries and (3) by changes in the pathology of the veins.

Formation of new vessels was observed on the cornea during the treatment of corneal opacities with the solution of benzyl cinnamate in man. This fact was confirmed experimentally on corneal opacities in animals.[3] New vessels are also formed on the conjunctiva during the treatment of trachoma by this drug.[4,5] During the treatment by this preparation of the chronic conductive type of deafness,[6] new vessels appear on the Shrapnell membrane of the drum. They are also formed on chronic inflammatory adhesions[7] and they appear in arteriosclerotic and diabetic retinopathy. (Fig. 1.)

The new vessels created by this drug are not formed as a result of strangulation of the vessels by newly formed connective tissue, as in proliferating retinitis or cirrhosis of the liver. They are not the result of compression of the vessels by a tumor or by an enlarged gland. Rather, they are the result of proliferation of the capillaries at the site of a lesion as it is observed in the healing of wounds.

CHANGES IN THE PATHOLOGY OF THE ARTERIES

The column of the blood stream in the arteries becomes more translucent and more thoroughly defined. The arterioles can be traced further to the periphery. The narrowing of the arteries decreases. The sheathing of the vessels diminishes and it is possible to observe gradual separation of an artery from a vein, both of which coalesced previously. (Figs. 2

FIG. 1. Diabetic retinopathy. A, before treatment. The fundus is hazy; retina slightly edematous. Blood columns in the arteries and veins are poorly marked. B, five weeks after beginning of treatment. The edema has diminished. The outlines of arteries and veins have become more distinct. C, eleven weeks after beginning of treatment. Appearance of some newly formed vessels from the inferior temporal artery and vein.

FIG. 2. Bilateral arteriolosclerosis, macular hole O.S. A, before treatment. There is marked attenuation of arteries. The blood column in the inferior temporal artery is interrupted in several places. At the margin of the disk, the inferior temporal artery is coalescent with a branch of the inferior temporal vein, and their blood columns cannot be traced. B, four weeks after beginning of treatment. Fundus is clearer. The outline of the vascular tree is more clearly defined. C, seventeen weeks after beginning of treatment. All of the vessels are clearly outlined and can be traced much further toward the periphery than in (A). The blood column in the inferior temporal artery is continuous. At the margin of the disk the artery becomes almost separated from the vein, and its blood column can be traced.

DIABETIC RETINOPATHY

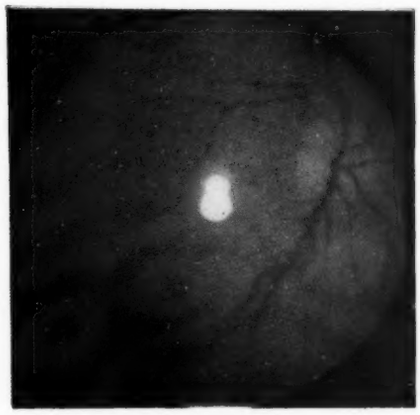

FIGURE 1A.

FIGURE 1B.

FIGURE 1C.

BILATERAL
ARTERIOSCLEROSIS
MACULAR MOLE O.S.*

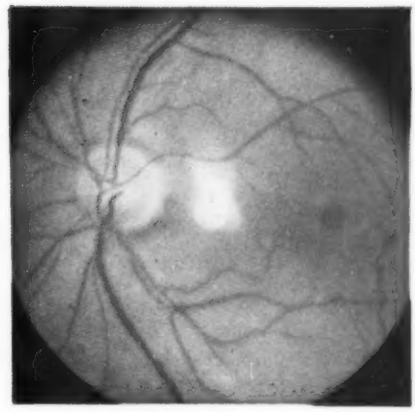

FIGURE 2A.

FIGURE 2B.

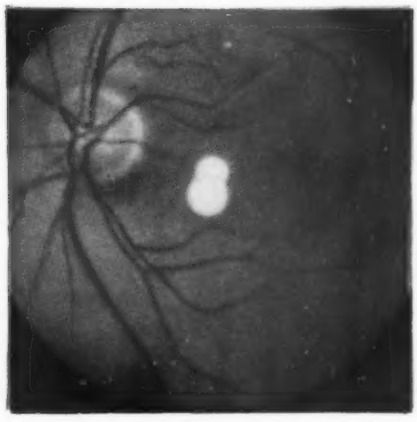

FIGURE 2C.

* ERRATA: Should be MACULAR HOLE O.S.

DIABETIC AND HYPERTENSIVE RETINOPATHY

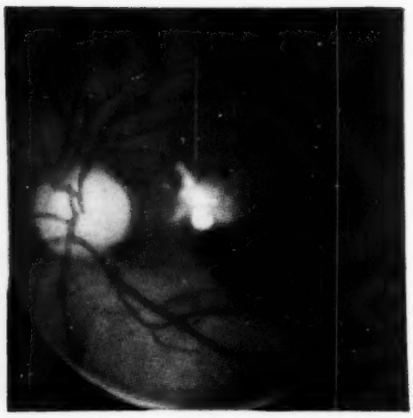

FIGURE 3A.

FIGURE 3B.

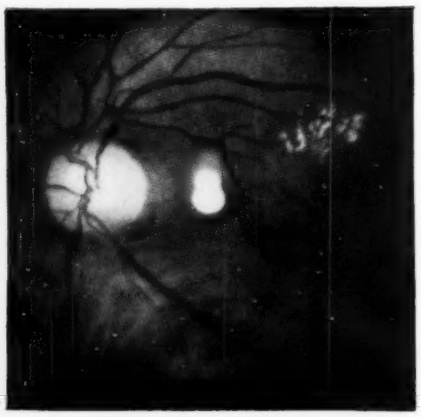

FIGURE 3C.

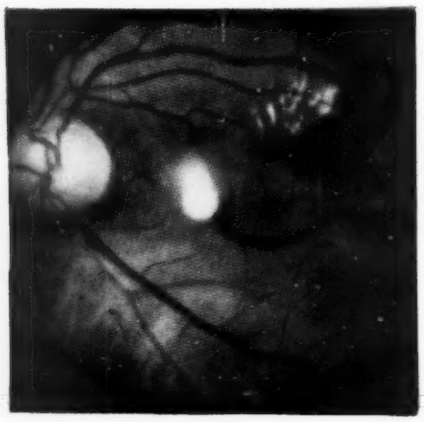

FIGURE 3D.

DIABETIC RETINOPATHY

FIGURE 4A.

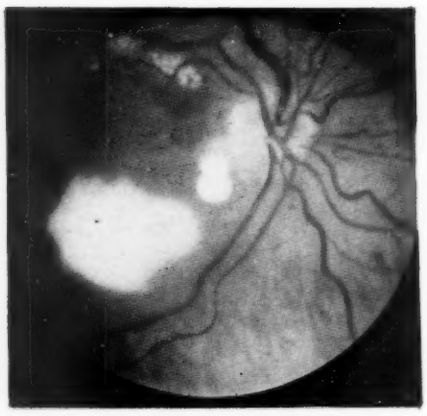

FIGURE 4B.

and 3.) These changes permit better filling of the arteries and their hydrostatic pressure will increase.

Physiology has established that the passage of the nutritive substances from the arteries into the tissue spaces depends upon the difference between the hydrostatic and the osmotic pressures of the blood at the ends of the arterioles where the hydrostatic pressure is 32 mm. Hg and the osmotic pressure is 25 mm. Hg. The difference of 7 mm. Hg forms the outward driving force which permits the passage of the nutritive substances from the arterioles into the tissue spaces.

When the lumen of the arterioles becomes narrow, less blood is circulating in the arterioles. The hydrostatic pressure is diminished and the outward driving force is decreased. Therefore less nutritive substances pass from the arterioles into the tissue, resulting first in local ischemia of the tissue and finally in a degenerative process.

The solution of benzyl cinnamate with vitamin A, increasing the lumen of the narrow arterioles, will increase their volume of blood. Consequently, their hydrostatic pressure becomes greater, the outward driving force is increased and the passage of the nutritive substances from the blood to the tissue is greatly facilitated.

CHANGES IN THE PATHOLOGY OF THE VEINS

The column of the blood stream in the veins becomes more translucent. The tortuosities of the venules and the caliber of the dilated venules gradually regress. (Fig. 4.) Consequently, the quantity of blood in the veins diminishes and their hydrostatic pressure decreases.

Physiology has established that the waste substances from the tissue pass into the blood by the inward driving force, resulting from the difference between the osmotic pressure and the hydrostatic pressures at the beginning of the venules. At this level the osmotic pressure of the blood is 25 mm. Hg and the hydrostatic pressure is 12 mm. Hg. The difference of 13 mm. Hg forms the inward driving force which will attract the waste substances from the tissue into the veins.

When the veins are tortuous and dilated, the increased hydrostatic pressure will decrease the inward driving force; less waste substances will then pass from the tissue into the veins and passive congestion with formation of edema and infiltration will result.

The solution of benzyl cinnamate with vitamin A, by its action upon the pathology of the veins as mentioned heretofore, will increase the inward driving force by diminishing the hydrostatic pressure. Therefore it will favor the passage of the waste substances from the tissue into the blood.

On the other hand, it will also increase the venous return by diminishing the quantity of blood in the veins and more blood consequently will circulate in the arteries.

The clinical results obtained by this drug* in the treatment of arteriosclerotic lesions of the retina and of the lower extremities are encouraging. Certainly caution and reservation are necessary when we speak of treatment of arteriosclerosis. Further experimentation should be carried out, and as time goes on it would be possible to judge better the exact results of this preparation in the treatment of arteriosclerotic lesions.

At the present time, I would like to limit myself to the following facts:

1. In a series of thirty-three treated cases of arteriosclerotic and diabetic retinopathy, twenty-five patients experienced improvement

* The material used in this study was supplied by E. Fougera & Co., New York, N. Y.

FIG. 3. Diabetic and hypertensive retinopathy. A, before treatment. The fundus is slightly hazy. There is preretinal hemorrhage below the macula. Partial star-shaped exudate between the macula and the papilla. The inferior temporal branch of the retinal vein is compressed by the corresponding artery below the margin of the disk, where they are both coalescent and their blood columns cannot be traced. B, eight weeks after beginning of treatment. Partial regression of the preretinal hemorrhage and the edema. C, twelve weeks after beginning of treatment. Continuous regression of the preretinal hemorrhage and the edema. The outline of the vascular tree is more clearly defined. D, eighteen weeks after beginning of treatment. The vessels can be traced further toward the periphery. The outline of the entire vascular tree is improved. The inferior temporal artery becomes almost separated from the corresponding vein below the margin of the disk.

FIG. 4. Diabetic retinopathy. A, twenty-two weeks after beginning of treatment. The fundus and the vascular tree were improved, but veins are still irregular in caliber, dilated and tortuous. B, thirty-four weeks after beginning of treatment. The caliber of the veins approaches normal values and their tortuosity diminished.

FIG. 5A. Aortogram taken before treatment. Occlusion of the left femoral artery at about the junction of the distal and middle thirds. Considerable collateral circulation at this level. Insofar as visualized, the vessels of the right thigh are normal.

FIG. 5B. Aortogram taken after ten weeks of treatment. The column of the blood stream in the arteries is more translucid. The arteries are better filled and their borders are sharply defined. Appearance of collateral vessels in the lower extremity of the femur. The arterioles can be traced further and their number is more evident in (B) than in (A). The x-ray did not definitely show the changes in the occlusion itself. However, the important increase in the caliber of the artery immediately below the occlusion (B) confirms that the obstacle to the passage of blood has decreased. Therefore the sclerotic lesion of the occlusion has diminished.

of vision in various degrees. These cases were chosen among patients who had not been improved by previous methods of therapy and whose vision was gradually diminishing.

The degree of improvement of vision depends on the pathology of the nerve. When there is destruction of the integrity of the nerve, no improvement can be expected; but when vision is impaired because there is a lack of blood supply to the nerve, as in arteriosclerosis, or when the perceptive power of the nerve endings is reduced by an inflammatory condition which involves them, the use of this drug will improve vision.

2. In a series of fifteen patients who were suffering from severe peripheral circulatory insufficiency, caused by obliterative arteriosclerosis, fourteen of these improved after injections of the solution of benzyl cinnamate with vitamin A. These patients had previously been treated by various methods without result.

The vascular changes induced by this drug allow better blood supply at the site of an arteriosclerotic lesion as it was established on the arteriosclerotic lesions of the retina. Better blood supply is also observed in the lower extremities as shown by aortograms. (Fig. 5.) Therefore pain, cramps and difficulty in walking, the symptoms caused by inadequate blood supply to the lower extremities, are improved with this method of treatment.

SUMMARY

The vascular changes caused by the solution of benzyl cinnamate with vitamin A at the site of an arteriosclerotic lesion are characterized: (1) by the formation of new vessels; (2) by better filling of the arteries, which blood stream becomes more translucent and more thoroughly defined; the arterioles can be traced further to the periphery; and (3) by gradual regression of the tortuosities and the dilated caliber of the veins.

The first clinical results obtained by this solution in the treatment of arteriosclerotic retinopathy and in peripheral vascular disease are encouraging.

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We recommend:

The Liver and Cancer. A New Cancer Theory. By Kasper Blond, M.D. Foreword by E. Stanley Lee, M.S., F.R.C.S. 220 pages. Baltimore, 1955. Williams & Wilkins Co. *Price* $6.50.

Surgery of the Stomach and Duodenum (A Handbook of Operative Surgery). By Claude E. Welch, M.D., D.SC. (Hon.). Illustrated by Muriel McLatchie Miller. Second revised edition, 370 pages, with 79 plates. Chicago, 1955. Year Book Publishers, Inc. *Price* $9.00. (In this book, planned as a practical guide, the most common and important operations that are performed on the stomach and duodenum have been selected for discussion.)

The Problem of Surgical Indication in Gallstone Disease

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DISEASE of the gall duct tract is one of the most common of all medical problems, and as such has provoked a rich literature from both medical and surgical groups. In spite of this, there are broad areas in which no unanimity of opinion exists between internists and surgeons as to precisely when, if at all, a patient with gallbladder disease requires surgical intervention. While a clear understanding of the pathologic physiology of the gall duct tract is basic to such a decision, only a knowledge of the natural history of this disease, based on clinical experience, can serve as an adequate guide. With this purpose in view it was decided to review all instances of disease of the gall duct tract appearing on the surgical service records of a general hospital during the course of the most recent two-year period, 1953 and 1954.* While such a period is admittedly short, it was deliberately chosen because it represents the present trend in the management of the disease in this area, providing at the same time a figure of reasonable statistical significance.

ANALYSIS OF MATERIAL

The diagnoses presented herein were made on operative findings and corroborated in each instance by pathologic examination. (Table 1.) A total of 132 cases were considered. As shown in Table 1, ninety-six of these patients had chronic cholecystitis as verified by pathologic section, eighty-three of which were associated with gallstones. Thirty-four cases of this subgroup had a history of jaundice, and in thirteen of these stones were found in the common duct at operation. Twenty-five patients had acute cholecystitis with empyema; all but one had stones in the gallbladder. Nine patients in this subgroup had associated jaundice; stones were found in the common duct in three of these patients.

Re-exploration of the common duct was performed on four patients: in three, for residual or recurrent stones following cholecystectomy done several years before; and in one, for a retained stone occurring in the present series.

There were seven cases of carcinoma of the gallbladder, an incidence in this series of 5.3 per cent. All of these were associated with stones and without exception occurred in female patients.

Three conditions were considered as complications of the basic disease: acute empyema, a history of jaundice and carcinoma. The determination of the percentage of operations performed for these complications was made on the basis of the original disease rather than the complication. Thus, although a patient may have had two complicating factors, e.g., empyema and common duct stones, they were considered a single complication. On this basis, the thirty-four cases of chronic cholecystitis associated with jaundice, the twenty-five cases of acute empyema, and the seven cases of carcinoma of the gallbladder form the irreducible minimum to be considered as complications of gallstones. These form a total of sixty-six instances in which operation was performed for a complication in a series of 132 cases of disease of the gall duct, an incidence of 50 per cent. Two deaths occurred in this series, giving a mortality rate of 1.5 per cent. One death occurred in a patient with an essentially uncomplicated case of chronic cholecystitis with stones. Autopsy reported the death as probably due to bile peritonitis. One death resulted from

* This does not include two cases of acute cholecystitis occurring in infants, which are clearly outside of the problem under discussion.

TABLE 1

STATISTICAL DATA ON PATIENTS WITH BILIARY TRACT DISEASE OPERATED ON DURING 1953–1954

	Chronic Cholecystitis	Acute Cholecystitis	Re-exploration of Common Duct	Carcinoma of Gallbladder	Total
No. of cases	96	25	4	7	132
Males	13	6	0	0	19
Females	83	19	4	7	113
Average age (yr.)	45	49	66	66	...
No. of patients with history of jaundice	34	9	3	3	49
Average length of history (yr.)	7	6	22	5.5	...
Average length of history of jaundiced patients (yr.)	10	9	25	5	...
No. of patients with stones in gallbladder	83	24	..	7	114
No. of patients having choledocotomy	26	9	4	1	40
No. of patients with stones in common duct	13	3	3	1	20

acute left ventricular failure and pulmonary edema. Sex distribution followed the usual marked female preponderance, the ratio being six females to one male.

PATHOLOGIC PHYSIOLOGY

Although the mechanism of the formation of gallstones is not well understood, the results of their presence in the gall duct tract are well known. Since symptomatic relief is often rapidly obtained, their presence may be disregarded until serious, far advanced changes have occurred. Furthermore, the etiologic factors considered most important in this mechanism such as local inflammation, stasis of biliary flow and disturbed cholesterol metabolism are certainly not physiologic. However, curiously enough, they are usually considered pathologic only when accompanied by severe symptoms. Gallstones cause symptoms when they attempt to escape from the bile passage, and by impaction may cause obstruction anywhere along the course of the cystic or common ducts with the development of hydrops or empyema of the gallbladder or jaundice. In the former the changes are at first chemical, but within forty-eight to seventy-two hours bacterial invasion is superimposed with the development of acute inflammation and necrosis of the wall of the gallbladder, eventual perforation and local abscess formation or, more rarely, generalized peritonitis. Obstruction of the common duct due to gallstones is usually partial and the results, while not as dramatic, are equally serious. The process is a much slower one, however, and long-standing obstruction of the common duct with repeated attacks of cholangitis will, in addition to bile retention, occasionally reveal pus in the hepatic and biliary radicles. Eventually the prolonged back pressure and superimposed bacterial invasion will result in biliary cirrhosis. More rarely one sees the passage of a stone directly into an adjacent viscus by a process of erosion with the formation of cholecystenteric fistulas.

INDICATIONS FOR OPERATION

Our indications for operation were based primarily on the following criteria: (1) a careful history of repeated gallstone colic; (2) roentgenologic evidence of stones; (3) a history of chronic cholecystitis as indicated by such symptoms as flatulence, distention, fatty food intolerance when associated with a non-visualizing gallbladder following ingestion of dye; and (4) attacks of jaundice.

A detailed history of gallbladder disease was considered more important than roentgenographic visualization of stones. Stones were visualized roentgenographically in 55 per cent of this series while the remainder revealed a non-functioning or poorly functioning gallbladder. Nevertheless, stones were found in 94 per cent of the gallbladders at operation. None of the patients in this series were operated on for incidentally discovered stones. However, it is our opinion that the presence of stones is an indication for surgery whether or not they are productive of symptoms, providing no surgical contraindication exists.

In patients having acute cholecystitis with empyema our policy has been early rather than

immediate or delayed operation, six to twelve hours being allowed for the correction of dehydration, anemia, electrolyte imbalance and tube decompression. Usually during this period patients with simple acute cholecystitis will show a complete regression of signs and symptoms, and operation can be performed electively in a quiet phase. When the process shows no signs of remission, operation is undertaken after this short interval of preparation. Observation during this brief period must be very close since changes manifested by increasing abdominal signs, rising temperature and pulse rate may signify an impending perforation requiring immediate laparotomy. The following case is an illustrative experience.

CASE I. I. R. (No. 40608), a sixty-eight year old woman, was admitted as an emergency case to the surgical service, complaining of right upper quadrant pain, nausea and vomiting of three days' duration. She had had four similar but less severe attacks during the past year. Three days prior to admission she had had a severe attack of pain radiating to the right shoulder. The pain had been continuous since onset and narcotics administered at home had given only short intervals of relief.

Physical examination revealed an obese, markedly dehydrated elderly woman. Temperature was 37.2°C., pulse 98 and blood pressure 170/60. There was marked direct and rebound tenderness in the right upper abdominal quadrant with only moderate rigidity. A mass could not be palpated. The blood count revealed 22,000 leukocytes. A diagnosis of acute cholecystitis was made, a tube was passed into the stomach, and the patient was placed on a regimen of intravenous fluids and antibiotics. She responded well to this therapy, with relief of pain and a fall in pulse rate. However, eight hours later there was a renewed attack of pain, a rise in pulse rate, and marked increase in abdominal tenderness and rigidity. The patient was covered with a profuse cold sweat and appeared very pale. Perforation was suspected and immediate laparotomy revealed a perforated, gangrenous gallbladder with free pus in the peritoneal cavity. The gallbladder was distended with thick green pus, the cystic duct being blocked by a small stone. Cholecystectomy was performed. The postoperative course was complicated by a wound infection, and eventration on the fourth postoperative day required secondary suture. Recovery was slow and the patient was discharged on the fifty-ninth hospital day.

Fortunately, this type of fulminating process is relatively rare and the remaining patients with acute cholecystitis made uneventful recoveries. All of them underwent early laparotomy within a twelve-hour period; cholecystectomy was performed in all patients. In five instances concomitant choledochotomy was carried out.

An ever-recurring problem has been the question of common duct exploration. Our indications have been rather broad, and it has been our belief that in doubtful cases it is wiser to explore. In addition to the obvious presence of palpable stones, we have considered the following as indications for choledochotomy: (1) a history of jaundice, (2) presence of many small calculi in the gallbladder, (3) dilated common duct, (4) dark, concentrated bile with sediment, (5) a chronic, contracted, thickened gallbladder without stones, and (6) chronic pancreatitis.

In spite of this, common duct stones are occasionally not discovered, as illustrated by the following case report.

CASE II. U. E. (No. 52882), a fifty-eight year old woman, was admitted to the surgical service with a twenty-year history of chronic disease of the gallbladder. There had been a single episode of slight jaundice seven weeks prior to admission, associated with severe pain in the right upper quadrant and vomiting. Since that time she had had daily attacks of pain. On admission the patient was not jaundiced, and the physical examination was essentially negative. Cholecystography revealed stones. At operation a small, contracted gallbladder with stones was found. Careful exploration of the common duct revealed no stones; probes could be passed easily into the duodenum. A tube was placed in the common duct. On the seventh postoperative day routine cholangiography revealed a block in the terminal portion of the common duct. Accordingly on the following day the duct was re-explored. Again palpation revealed no abnormalities. Only after mobilization of the duodenum by division of the lateral peritoneal reflection[1] could a stone be felt in the region of the papilla. The stone, the size of a small olive, was removed and immediate cholangiography was satisfactory.

Operative cholangiography is a method of

value in reducing the incidence of retained stones. However, reports[2,3] indicate it to be something less than accurate, and the surgeon is faced with the fact that only a methodical exploration of the duct, at times with mobilization and opening of the duodenum, will enable him to reduce the incidence of retained stones to a minimum.

COMMENTS

As shown in Table 1, this series of cases has been classified into groups labelled chronic cholecystitis, chronic cholecystitis with jaundice, acute cholecystitis and carcinoma of the gallbladder. Clinically, insofar as surgery is concerned, and pathologically, such a classification is of value. Actually, however, any such classification is an artificial one since basically each of these groups is the result of a single original problem, that of gallstones. They are serious extensions of the original disease, or, more simply stated, complications resulting from gallstones which have been conservatively treated until such time when complicating factors have seriously endangered the patient and a more effective approach is urgently required.

In Table 1 it can be seen that of the total 132 cases, sixty-six were associated with one or more of the complications of empyema, jaundice or carcinoma, so that 50 per cent of the operations performed were for complications of the disease. With one exception, all of these complications were associated with stones. It may be argued with some justification that these figures are based on a hospital population and therefore the percentage of complications is artificially high, since patients with complications naturally find their way to the hospital. However, this argument breaks down if one notes the length of history in Table 1. The increasing incidence of complications is noted as the history becomes longer than five years. Unfortunately, no accurate statistics exist as to the precise incidence of gallstones among the general population. It is readily conceded that 50 per cent of those persons having gallstones do not have associated serious complications at any given time. However, there is some evidence to show that in a percentage approaching this figure such complications may eventually develop if conservative measures are employed for more than five years.

The question is often asked as to whether any harm results from waiting for these complications to develop. In addition to biliary cirrhosis and chronic pancreatitis, which develop in the presence of long-standing partial obstructions, the operation early in the disease is essentially a simple one. In late stages it may require a dissection as difficult and as dangerous as any in the long list of established surgical procedures. The present controversy which has arisen among surgeons concerning early or delayed intervention in cases of acute cholecystitis (a discussion beyond the scope of this paper) is in itself an indication of the serious nature of this complication with its attendant problem of peritonitis. Obviously, when stones are present, the proper solution is early elective operation. The problem then need never arise.

Thirty-five patients in the series (29 per cent) underwent concomitant choledochotomy, the most urgent indication being a previous or present history of jaundice. Stones in the common duct were found on sixteen occasions. In those patients with jaundice in whom common duct stones were not found, one must assume that the obstructing stone had passed the papilla, or was overlooked, or that the jaundice was due to associated cholangitis. One patient in the group required reoperation for a retained stone revealed by the postoperative cholangiogram. Only time will determine whether or not a stone was overlooked in the remaining patients, although with one exception, the postoperative cholangiograms were all negative.

It is significant that the average history in the group complicated by jaundice was ten years. Three patients had common duct explorations following cholecystectomies done several years before. Whether these stones were newly formed or residual stones previously overlooked is difficult to say. There is no question that a long-standing history of gallstones predisposes to the formation of common duct stones, and because of the anatomic arrangement of the mucosal folds in the terminal portion of the duct, stones in this region may be overlooked. The incidence of such error is reported to be as high as 20 per cent.[3] It is clear that early operation on patients with gallstone disease would, to a large extent, limit the necessity of common duct exploration and therefore of re-exploration.

Insofar as carcinoma of the gallbladder is concerned, it is our belief that the problem is a similar one. This is not to say that carcinoma of the gallbladder is the direct result of gallstones.

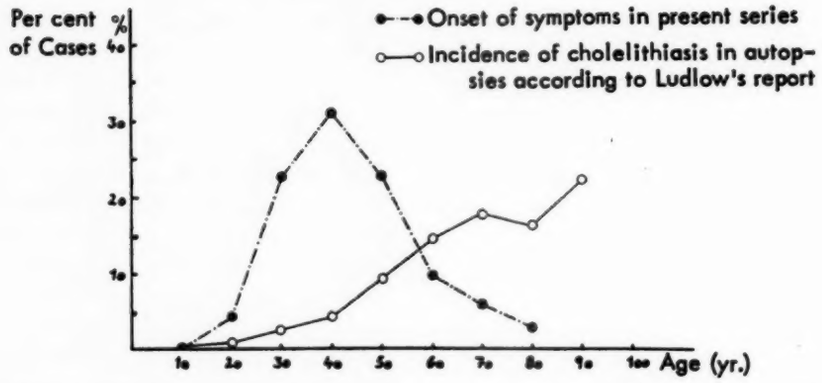
Per cent of Cases %
4o
3o
2o
1o
Onset of symptoms in present series
Incidence of cholelithiasis in autopsies according to Ludlow's report
1o 2o 3o 4o 5o 6o 7o 8o 9o 1oo Age (yr.)

FIG. 1. Graphic representation showing incidence of stones in relation to age in present series and in autopsy group.

However, it is almost always associated with gallstones,[4] as were all of the seven cases in this series, and usually with lengthy histories of gallstone symptomatology. Therefore, from a clinical aspect, the problem as to whether or not carcinoma of the gallbladder is a direct result of stones is essentially an academic one, if it is borne in mind that cholecystectomy early in the life history of cholelithiasis would eliminate the site and so avoid one of the deadliest of intra-abdominal malignancies. The problem is not an inconsiderable one since the incidence in different series varies from 0.71 to 16 per cent.[5] Our incidence is 5 per cent. It is probable that the average is near this figure. In itself, carcinoma is only a small factor in the over-all problem, and routine cholecystectomy in the presence of stones could not be advocated for this reason alone. However, it is a reinforcing factor for more urgent indications. It is interesting to note that these seven instances of carcinoma occurred exclusively in women. Since gallstones are so overwhelmingly a disease of women there may be some significance in this relationship.

TABLE II

Age (yr.)	Incidence of Cholelithiasis in Relation to Age (Ludlow's Report on 4,800 Autopsies) * (%)	Onset of Symptoms in Relation to Age (Present Series of 132 Operated Cases) † (%)
0–10....	0.00	0.00
11–20....	0.91	4.54
21–30....	2.75	22.72
31–40....	4.27	31.06
41–50....	9.20	22.72
51–60....	14.47	9.84
61–70....	17.86	6.06
71–80....	16.25	3.03
81–90....	22.22	0.00
91–100...	0.00	0.00

* Maximum incidence between ages 51–90.
† Maximum incidence between ages 21–50.

Thus, of the operations undertaken on the gall duct tract in this hospital during a two-year period, 50 per cent were for complications resulting from gallstone disease under prolonged conservative therapy, and would indicate a tendency in this direction in a significantly large group of physicians. This percentage is somewhat higher than that reported elsewhere. The Mayo's report that 25 per cent of the operations done for gallstones in their clinic are for complications of the disease.[6] The conclusion is almost inevitably drawn that prolonged conservative therapy in the presence of stones is dangerous and that operation should be undertaken when the diagnosis is made. This is no new concept. However, judging by these and other statistics, it has not been generally accepted.

An objection to this concept that is commonly raised is the apparent widespread incidence of the disease, often asymptomatic, which would result in innumerable unnecessary cholecystectomies, autopsy reports being cited in support of this contention. Practically, this problem is more apparent than real. (Table II, Fig. 1.) Very few asymptomatic gallstones are inadvertently discovered. Furthermore, the average incidence of gallstones discovered at autopsy is 9 per cent, the majority of which only begin to appear in significant numbers in the sixth decade, finally reaching their peak in the eighth and ninth decades.[7] In this series the onset of symptoms in the great majority of

patients occurred in the third, fourth and fifth decades.

In Table II this series has been charted according to the patient's age at onset of symptoms, the number of cases in each decade being expressed in per cent. This is compared to a similar chart compiled by Ludlow[7] from autopsy reports. It is interesting to note that in the present series the figure becomes significantly large in the third decade and falls sharply at the end of the fifth decade at a time when the autopsy group is just becoming significantly large. Judging from the autopsy figures it would seem that the incidence of gallstones during the first half of the life span is low. However, the comparative table (Table II) shows that when they do occur in this period they will eventually become symptomatic, probably because of the time factor. If treated conservatively they will eventually produce complications in a significantly large group. Although, in comparison to the autopsy group, the present series is statistically small, the inference in this direction is strong.

SUMMARY AND CONCLUSIONS

1. A series of cases of biliary tract disease appearing on a general surgical service over a two-year period is presented.

2. Fifty per cent were operated on for complications developing from gallstones treated conservatively.

3. As the history extends beyond five years, complications occur with increasing frequency.

4. Gallstones developing early in life have a greater likelihood of developing these complications than those occurring later in life, probably because of the time factor.

5. Operation should be performed for gallstones when the diagnosis is made, providing no contraindication to surgery exists.

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The Unstable Knee

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THE unstable knee remains a difficult problem in treatment. Several excellent studies on function and anatomy[1,4,5,9] have been reported. Gross features of mechanics and anatomy will be touched on briefly herein.

The patellar tendon and the quadriceps aponeurosis constitute the ligamentous structures of the front of the knee joint and function as a hood mechanism.* The fat pad and synovia lie beneath. A capsule does not exist anteriorly. Laterally the fascia lata and the biceps tendon blend with the quadriceps expansion. Beneath the fascia lata lies the collateral ligament* and the popliteal tendon. The capsule exists posteriorly and is composed of coalition of investing fascia of contiguous structures. Medially the quadriceps expansion blends with the pes anserinus and the semimembranosus tendon. The medial collateral ligament is discrete, is inserted 3 inches below the tibial plateau beneath the pes anserinus and is usually attached to the tibial plateau. The posterior capsule lies just anterior to the gastrocnemius muscle at the joint level and is intimately connected with the posterior cruciate ligament in midline. The cruciate ligaments are in the intercondylar notch and are well illustrated in anatomy texts. The posterior cruciate ligament is fairly perpendicular, running from the medial femoral condyle in an oblique direction to the posterior mid-tibial plateau. The anterior cruciate ligament runs from the intercondylar notch obliquely forward to the inferior and slightly medial aspect of the tibial plateau. These ligaments have membranous plica that carry blood supply, more prominent to the posterior than anterior cruciate ligament. The popliteal artery is adjacent to the posterior knee capsule. The tibial spines are buttressing counterparts to the femoral condyles.

By way of gross mechanics, the cruciate ligaments hold the tibial plateau apposed to the femoral condyles. This function supplies the single greatest stabilizing force in the structure of the knee joint. Chronic loss of one cruciate ligament imparts permanent instability to the knee joint, more serious if the missing element is the posterior cruciate ligament. Due to their crossed nature the cruciate ligaments do not resist rotation of the tibia on the femur and permit some varus and valgus play at the knee joint; they resist the drawer signs of fore and aft motion of the tibia on the femur in the sagittal plane.

The collateral ligaments are taut with the knee extended to station 180 degrees and relaxed somewhat in knee flexion, particularly the external collateral ligament. The collateral ligaments resist varus and valgus deformity with the knee extended and resist rotation with the knee extended but permit some rotation with the knee flexed. The external collateral ligament does not resist the drawer sign with the knee flexed, but the medial collateral ligament does to some degree.

The cruciates, particularly the posterior cruciate, and posterior capsule resist recurvation of the knee joint. In flexion of the knee joint the cruciate ligaments, hamstrings and quadriceps musculature stabilize the knee joint.

In summary, the cruciate ligaments hold the tibial plateau closely apposed to the femoral condyles, resist fore and aft motion of the tibia on the femur in the sagittal plane (drawer

* A joint capsule is a ligamentous structure passing between two adjacent bone ends and supplying static stability to the resulting joint and allowing enough motion to permit muscle function in moving the joint through a normal range. A discrete portion of a capsule may be termed a ligament. A joint hood mechanism is a termination of muscular apparatus that originates on one or more bones, crosses a joint and inserts on another bone which forms part of the joint and is designed to motivate the joint, specifically through varying degrees of extension. A collateral ligament passes between two bones at a joint, is paired, is associated with a hood mechanism, permits approximate hinge motion, usually in the sagittal plane.

signs) but permit some varus and valgus motion of the tibia on the femur and rotation of these elements. The collateral ligaments in full extension prevent varus and valgus of the tibia on the femur and impede rotation but do not prevent the drawer signs, and allow in flexion of the knee some rotation and varus and valgus instability. In knee flexion, stability is more dynamic than static. In full extension the knee locks in position utilizing the bony architecture and all sustaining ligaments.

Loss of a single collateral ligament results either from rotation of the tibia on the femur or from varus or valgus deformity stopping short of cruciate ligament rupture. A single cruciate ligament rupture results from hyperextension or fore and aft motion of the tibia on the femur. A combined or double ligamentous rupture can result from varus or valgus force applied to the knee, and can also be created by combining rotation, fore and aft motion or abnormal varus or valgus motion. The knee joint is not completely a hinge joint; hence the collateral ligaments are not effective throughout the normal range of the knee joint. The medial collateral ligament is more of a stabilizing force than the external collateral ligament.

In the extended position the knee ligaments supply their greatest stabilizing effect, in flexion the thigh musculature and the cruciate ligament offer the greatest stabilizing effect. With abduction or adduction of the knee joint, or fore and aft stress in the sagittal plane, most of the effect is upon the ligamentous apparatus. The musculature is designed to bend the joint and stabilize the joint angle, but not to protect it from unphysiologic motion directed in other than the sagittal plane.

The medical literature relating to ligamentous repair of the knee joint deals largely with anatomy and function, or the results of fascial transplant. Free fascial transplant to correct a ligamentous defect has not proved practical. The fascia does not effectively stabilize the joint. Use of free fascia or fascia left attached at one end offers no advantage as vascularity is often not retained and the retained attachment is invariably in the wrong location. In collateral ligament repair the reconstructed ligament must pass between the normal origin and insertion to insure stability with subsequent motion. Only the collateral ligament passes between these points. Free transplants of any material to reconstruct the collateral or cruciate ligaments have not been shown to be practical. Repair of the collateral ligament by use of a tendon of the pes anserinus left attached distally and fixed proximally on the femur is perhaps a useful method, but one with which I am inexperienced.[3] Free transplants, or those left attached at one end, used to replace a cruciate ligament rarely survive as an effective structure.

Criteria upon which to base evaluation of a knee with repaired ligamentous structures have never been established. The literature is singularly bereft of critical follow-up studies of knee joint ligamentous repairs for chronic defects. My experience has shown that perception of ligamentous defects of the knee is a difficult problem not mastered by everyone. Slight thigh muscle tension by the patient during examination will obscure a major ligamentous rupture. In describing symptoms associated with such a defect the patient usually relates that the knee "goes out" or "throws" him. He usually refers to a jump sign or locking from a meniscus tear, abnormal varus or valgus mobility due to a ruptured collateral ligament, a drawer sign (often occurring while the patient is going up and down stairs) due to a cruciate lesion, or the abnormal motion in flexion from a combined cruciate and collateral ligament rupture. Some patients cannot demonstrate abnormal motion. A moderate drawer sign may be shown at operation to be based upon complete absence of the involved cruciate. Differentiation between a "wobble" sign (Fig. 1, cruciate laxity) at 180 degrees of extension and a collateral ligament defect requires experience but is an important element. Ruptured ligaments heal to some extent after injury and all degrees of laxity may be observed. Comparison with the normal knee is necessary as some normal joints are more lax than others. Rupture of a cruciate ligament in a knee with intact collateral ligaments will demonstrate an instability in moderate flexion of graphic character. (Fig. 2.) In moderate flexion (say 20° at station 160 degrees) when relaxed, the knee may be thrust sideways and one femoral condyle will raise off the tibial plateau. This results because the external collateral ligament relaxes with flexion and the mass of the femoral condyle is uncovered as the anterior fibers of the medial collateral ligament move posterior. Hence prohibiting abnormal varus or valgus motion in flexion of the knee joint resolves upon the cruciate ligaments. This finding is best illus-

trated with the patient standing on his good leg with his injured leg flexed to 25 or 30 degrees and the leg relaxed with toes resting lightly upon the floor.

Chronic ligamentous defects of the knee joint fall into three main groups: (1) ruptured cruciate ligament, (2) ruptured collateral ligament and (3) rupture of the posterior capsule.

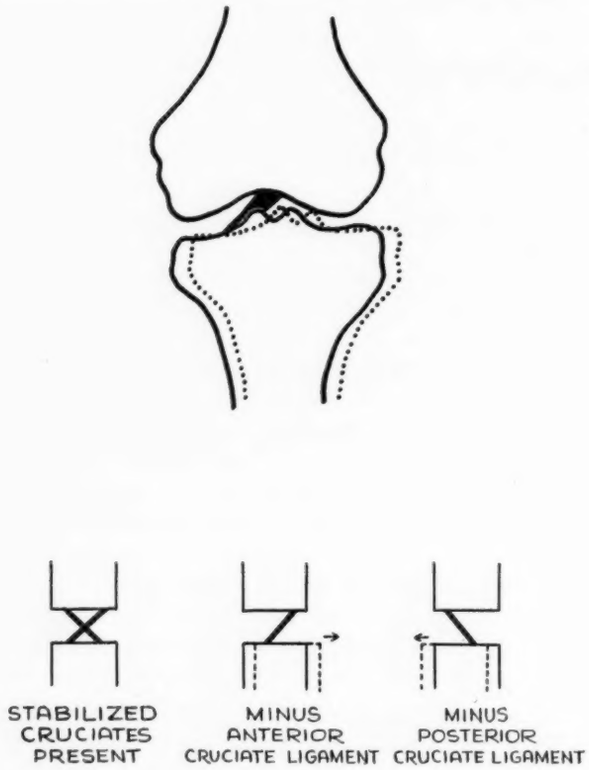


FIG. 1. Illustration showing lateral shift, or instability, of the tibia on the femur at station 180 degrees of extension with ruptured cruciate ligament and intact collateral ligaments. Confusion between a rupture of a cruciate and rupture of a collateral ligament may result in attempting the wrong operative procedure.

Repair of a chronic cruciate ligament rupture resulting in return to a normal state appears impossible at the present time. Such a knee joint will always show some instability and laxity despite reparative measures. (Repair of acute ruptures may result in a normal joint.) Therefore, in considering knee joints with chronic ruptures, those with cruciate defects, which will be the vast majority, should be represented to the patient as possible of improvement but not cure. On the other hand, the chronic rupture of a collateral ligament may be repaired with good chance of considerable and permanent improvement. Ligamentous repair of posterior recurvation due to chronic posterior capsule and posterior cruciate defect has not been successfully attempted.

Treatment of acute ligamentous injuries should be prompt surgical repair.[8] A fairly normal knee may be the reward. Conservative treatment of acute ligamentous injuries creates our current crop of chronic defects. These remarks concern chronic defects exclusively. Degree of ligamentous defect and associated disease influence the terminal result of repair. A single chronic defect is more likely to result in a fairly normal knee. The quality of the final result is lowered by an associated pathologic condition such as arthrofibrosis, osteochondritis dissecans, osteomalacia, ruptured menisci, degenerative joint disease, atrophy of the quadriceps muscle and sequelae of fractures. Repair of ligamentous defects will not improve these other conditions. Double ligamentous defects will retain some joint impairment. Single chronic collateral ligament rupture gives the best result after repair and occurs infrequently.

Repair of collateral ligaments has been found best by utilization of viable existing structures.[2,6,7] The ligament is usually present but healed in a relaxed state. Mobilization of the proximal origin of either collateral ligament is a simple surgical procedure. (Figs. 3 and 4.) A block of bone 1 cm. square and 0.5 cm. thickness is advanced proximally to a taut condition and fixed in position with a boat nail. The repair must be protected postoperatively or the effect of the long lever arms of the thigh and lower leg will be to loosen the repair. A long leg cylinder or a hip spica has not been effective in protecting the collateral origin advancement. If skeletal fixation is not used, a long plaster splint should be applied on the side of repair and kept lashed snugly to the leg proximally and distally. A piece of felt should be placed beneath the splint over the knee joint and should be removed when the plaster has hardened in order to prevent knee joint pressure. Assiduously cared for, a plaster splint affords good protection for collateral ligament repair: A figure-of-eight bandage (6 inch ace bandages) should be used about the hip and waist to maintain the upper limits of the plaster splint. The knee is held at 180 degrees extension for four to six weeks. The distal portion of the ligament need not be mobilized. Instability due to collateral ligament defect is

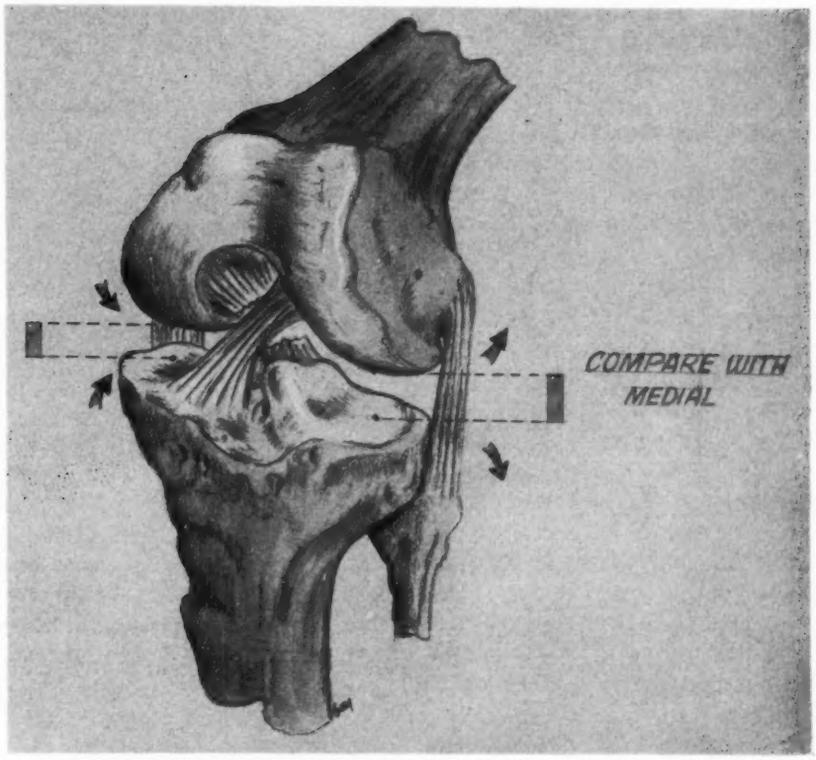


FIG. 2. Instability present in the knee with moderate flexion with rupture of one cruciate ligament and intact collateral ligaments.

evident principally with the knee extended. On each side of the knee the fascia should be closed separately over the advanced collateral ligament; externally the fascia lata is more distinct than the medial fascia.

Repair of the cruciate ligaments involves dynamic substitution of a tendon for the ligamentous defect. (Figs. 3 and 4.) Joint repair in the knee resembles shoulder reconstructions in that dynamic substitution (subscapular advancement) or advancement of existing viable ligamentous structures (suture of capsule) is utilized. The medial one-third of the patellar tendon is transplanted to one-third the distance posterior on the tibial plateau to replace functionally the posterior cruciate ligament. The transplant is buried in a bony tunnel as shown in Figure 4. This altered angle of pull of the powerful quadriceps through the patella acting as a fulcrum tends to stabilize the damaged knee in flexion in the sagittal plane. Rupture of the anterior cruciate ligament is replaced by the dynamic action of the transplanted semitendinosus tendon inserted through the intercondylar notch and into the tibial plateau at the insertion of the anterior cruciate ligament. (Fig. 3.) The transplanted tendon enters from the upper limits of the popliteal space, passes external to the artery and under the sciatic nerve, and enters proximal to the gastrocnemius vessel and nerve supply. The dynamic effect of this operation is to stabilize the tibial plateau on the femur in conjunction with the posterior cruciate ligament when the hamstrings are contracted. Patients undergoing cruciate ligament repair are kept in a plaster splint for three weeks, but are allowed up on crutches with partial weight bearing at once. The "wobble" sign is a permanent residual of chronic cruciate defect and should not be confused with collateral ligament laxity. Repair of the anterior cruciate ligament gives better results than repair of the posterior cruciate ligament, but the latter disability is more serious to begin with.

Postoperative management includes judicious and vigorous physical therapy. Some patients respond slowly and incompletely by muscular hypertrophy to conditioning. The medical literature frequently reflects the concept that muscular conditioning, particularly of the quadriceps, will substitute for treatment

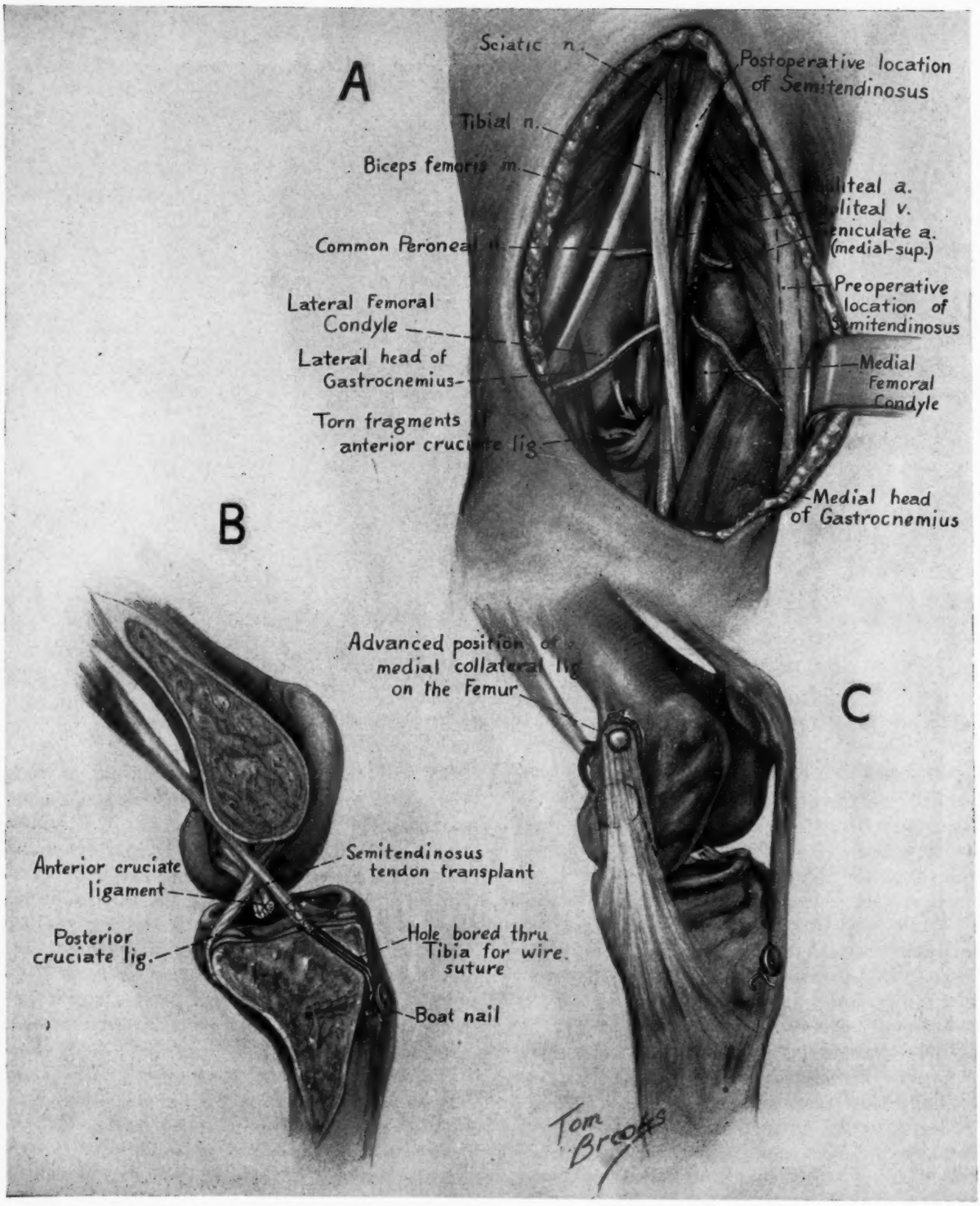


FIG. 3A to C. A, transplant of the semitendinosus tendon from the pes anserinus to the front of the knee joint through the intercondylar notch, beneath the nerve and external to the artery (shown in another diagram under Figure 3E). B, cut-away view of the knee joint showing transplant of semitendinosus tendon into the intercondylar notch with method of fixation in a bony tunnel in the tibial plateau, dynamically replacing ruptured anterior cruciate ligament. C, proximal advancement of the origin of the existing viable tissue of the medial collateral ligament. (From SPEED, J. S. and KNIGHT, R. A., Editors. Campbell's Operative Orthopaedics, 3rd ed. St. Louis, 1956. C. V. Mosby Co.)

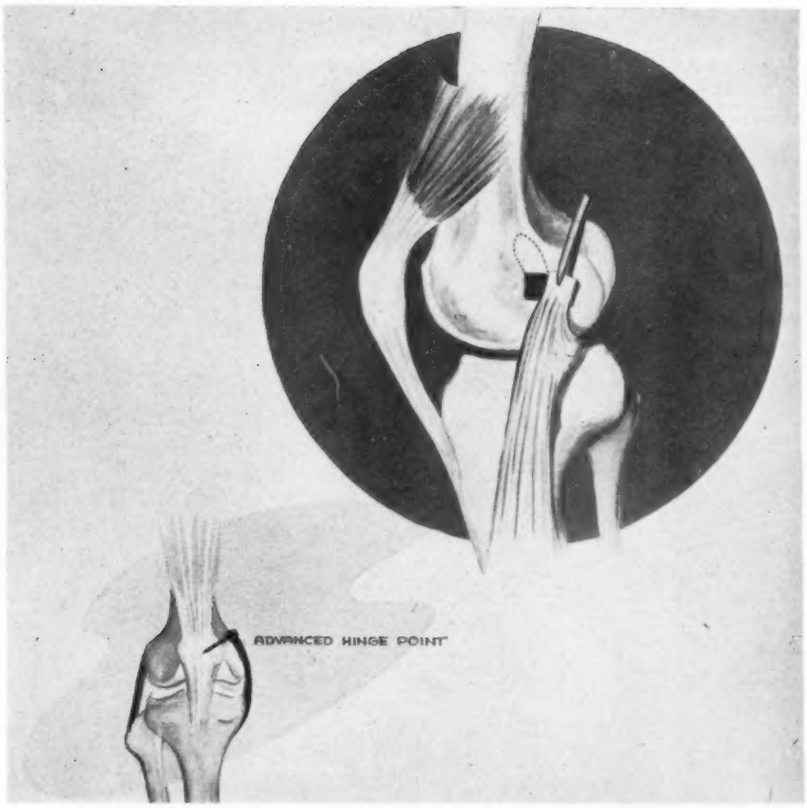


FIG. 3D. Proximal advancement of origin of medial collateral ligament for healed rupture with laxity. (From SPEED, J. S. and KNIGHT, R. A., Editors. Campbell's Operative Orthopaedics, 3rd ed. St. Louis, 1956. C. V. Mosby Co.)

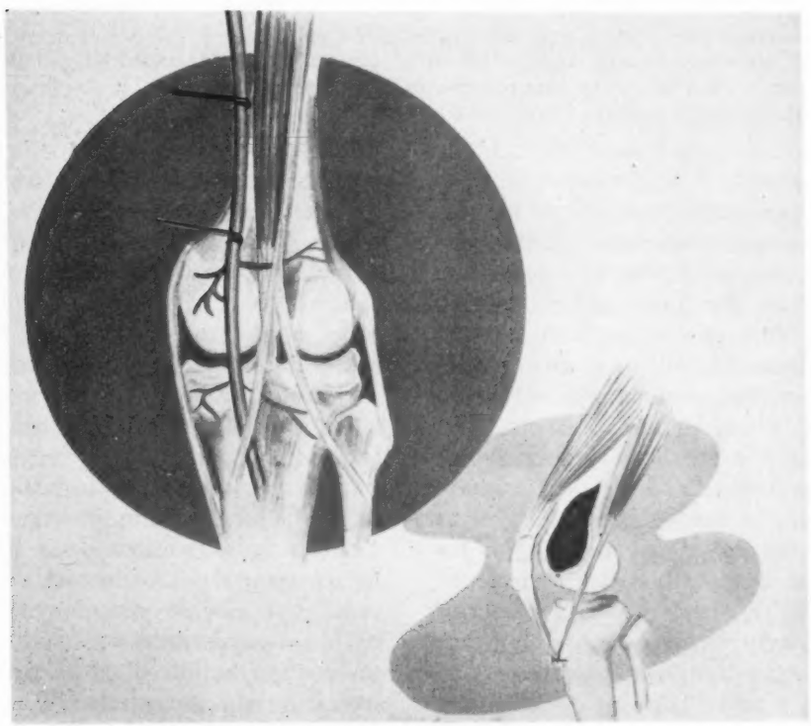
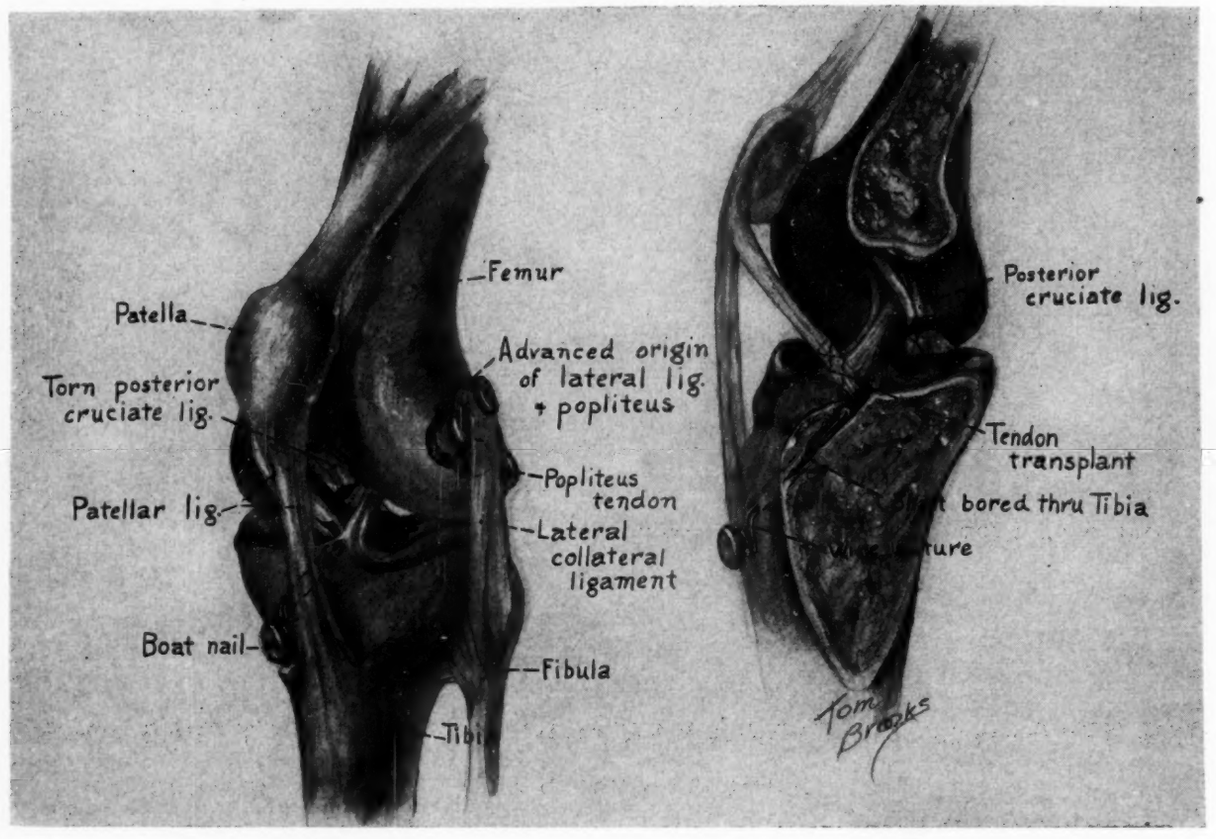


FIG. 3E. Diagram reveals transplant of the semitendinosus tendon through the intercondylar notch beneath sciatic nerve and external to popliteal artery to stabilize the knee joint dynamically with absent anterior cruciate ligament.

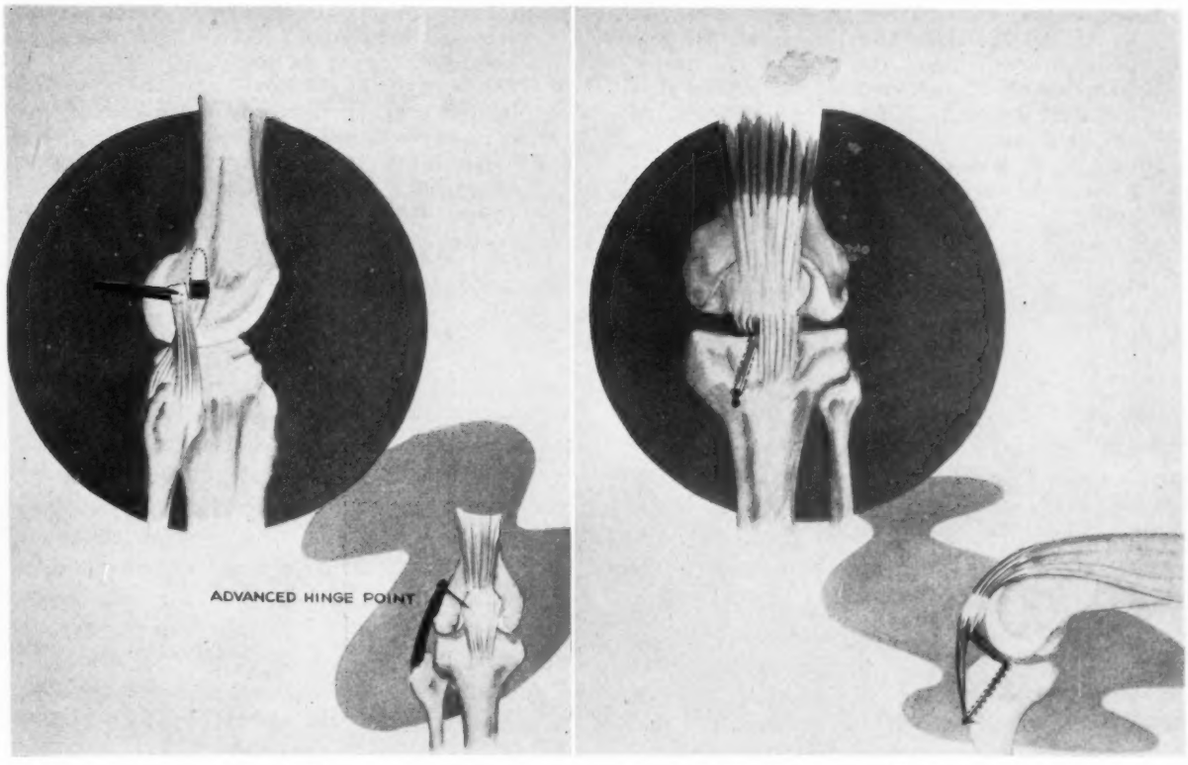


4A 4B

FIG. 4A and B. A, posterior transplant of part of the patellar tendon to replace dynamically rupture of the posterior cruciate ligament. B, cut-away view of the same showing placement of the transplanted patellar tendon segment and method of fixation in the tibial plateau. (From SPEED, J. S. and KNIGHT, R. A., Editors. Campbell's Operative Orthopaedics, 3rd ed. St. Louis, 1956. C. V. Mosby Co.)

of ligamentous defects. This is not so. The patient will remain subject to instability. (Fig. 1.) Further the opinion is often recorded that the cruciate ligaments are of lesser importance. Actually they are the principal sustaining ligamentous elements of the knee. A patient may accommodate himself to any single ligamentous defect, but he never will return to the "commando" class. Repair of all elements ruptured or relaxed is advised, as each repair will add to the final result. The relaxed cruciate ligament often allows the femoral condyles to ride over the meniscus. If the meniscus is removed, it should be totally excised and the cruciate ligament repaired as well. Posterior cruciate defects were formerly infrequent but are now as common as anterior cruciate defects among our cases.

Evaluation of results of repair of the knee ligament involves the absence of varus or valgus abnormal mobility and the capacity of the patient to indulge in moderate physical activity without his previous instability. Objective evidence of the initial and subsequent instability, or lack of it, is difficult to record. The terminal analysis is apt to be apparent to only the surgeon and the patient, and even then may not be unanimous. Compensation associated with instability of the knee joint will often alter unfavorably the apparent final result. Individuals judged by the surgeon to have similar pathologic conditions and similar results will often claim divergent benefits. The repaired single defect does well; the double ligamentous defect, uncomplicated, does fairly well. The double defect with an associated pathologic condition does less well. The period of immobilization of the knee joint for collateral repairs is undesirable and impedes conditioning, but such is mechanically necessary to prevent destruction of the repair. The repaired cruciate defect will retain knee laxity on



4C 4D

FIG. 4C and D. C, proximal advancement of the existing viable tissue of the relaxed external collateral ligament. D, another diagram showing transplant of part of the patellar tendon posterior on the tibial plateau dynamically to substitute for rupture of the posterior cruciate ligament. (Fig. 4C taken from SPEED, J. S. and KNIGHT, R. A., Editors. Campbell's Operative Orthopaedics, 3rd ed. St. Louis, 1956. C. V. Mosby Co.)

test with relaxed musculature. Like others, I am unable to give a final objective evaluation of patients subjected to these four operative procedures, twenty-five in number since early in 1953.

SUMMARY

The cruciate and collateral ligaments and the posterior knee capsule are the sustaining ligamentous apparatus of the knee. The bony configuration and dynamic musculature action complete the stabilizing structures of the knee joint. Acute injuries should be repaired at once, suturing discrete ruptured ligaments. Collateral ligament origin advancement, using available viable structures, is advised for chronic collateral defects. Cruciate ligament repair by dynamic substitution of transplanted tendons, one-third of the patellar tendon for the posterior cruciate ligament, the semitendinosus tendon for the anterior cruciate, is suggested. Repairs using free transplanted substances have not proved successful. Rigid postoperative fixation for collateral ligamentous defect is advised. The double ligamentous defect will never return to normal but will be improved. A permanent "wobble" sign accompanies all chronic cruciate ligament defects. The detection of ligamentous instability requires careful examination and experience. Criteria for evaluating repairs of the knee ligament have not been established. A knee with multiple pathologic conditions will not return to normal following these suggested procedures. Local infiltration is the anesthesia of choice.

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Gastropexy As the Lone Procedure in the Surgical Repair of Hiatus Hernia

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GASTROPEXY was proposed as an aid in the surgical relief of hiatus hernias in 1954, the technic also being detailed at that time.[1]

In the interim period additional experience has been gained with this procedure while Boerema and Germs,[2] without knowledge of it, have recently described a procedure which in principle is very similar.

According to our technic, the hernial sac and ring are left intact while the stomach is secured to the anterior abdominal wall. This can be achieved by entering the abdominal cavity through a left pararectal incision, by which procedure the stomach and the pylorus may be redrawn into the abdomen through the strangulating ring without difficulty. A pedicle flap is next prepared by using fascia from the rectus muscle and this is sutured to the anterior wall of the stomach after the latter has pulled caudally to a maximum extent. The free end of the flap is exteriorized through the incision and its edges are sutured to the sheath of the rectus muscle. To conclude, the anterior part of the stomach is attached to the parietal peritoneum at the point of incision. (Fig. 1.)

Two patients, already reported on in 1954 as having been treated with this procedure, were seventy years of age at the time of the operation for an incarcerated stomach and colonic segment. To date both patients are free of symptoms. One of these patients, in whom a

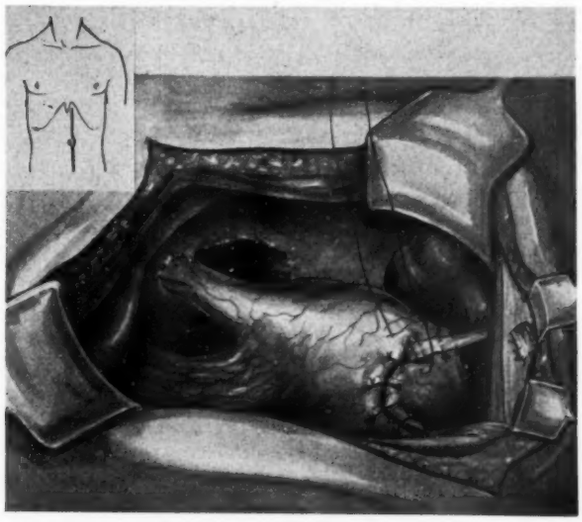

FIG. 1. From a left pararectal incision the herniated part of the stomach and colon is redrawn into the abdomen; the cardiac part is fastened to the anterior abdominal wall by pedicled flap of the rectus fascia and by stitches connecting the gastric serosa with the parietal peritoneum.

FIG. 2. A large paraesophageal hernia, diagnosed twenty years before operation, is incarcerated. Gastropexy was performed as an emergency procedure.

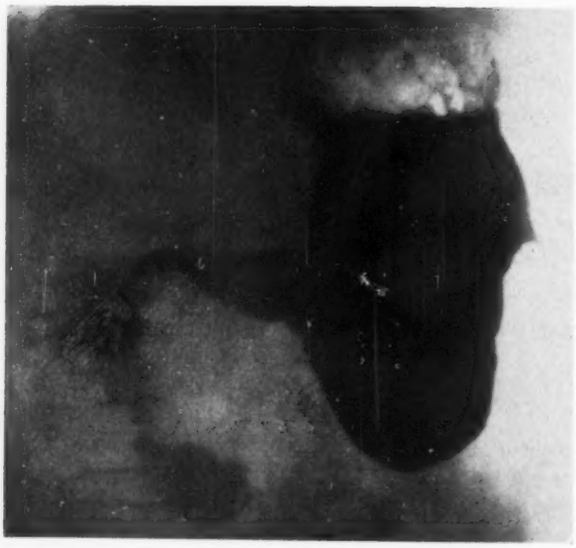

FIG. 3. Same case as Figure 2. Stomach is in normal position four years later. Tenting at the greater curvature is probably caused by gastropexy.

paraesophageal hernia had been present for twenty years, has resumed full time practice of medicine, and repeated roentgenologic examination has revealed no displacement of the abdominal viscera despite the continued presence of the hernial opening. Remission in these two patients has lasted six and ten years, respectively. (Figs. 2 and 3.)

The present procedure developed from the observation that certain patients with incarcerated hernias come to operation as poor surgical risks due to their old age and their debilitated general condition. In such circumstances it is advisable to limit oneself to repositioning of the herniated segment and its attachment within the abdominal cavity. Gastropexy has been devised as a method to this end. Transverse colon, left flexure and spleen, which due to their mesenteric attachment frequently follow the stomach into the hernial sac, are prevented from sliding back through the opening by the aforementioned suturing of the stomach. This applies to sections of the small bowels that may have become displaced transdiaphragmatically as well. If the attachment of the stomach to the anterior abdominal wall is sufficiently wide, the remaining viscera have no path by which they may herniate.

Since the earlier report, two additional cases have been observed. One, an eighty year old

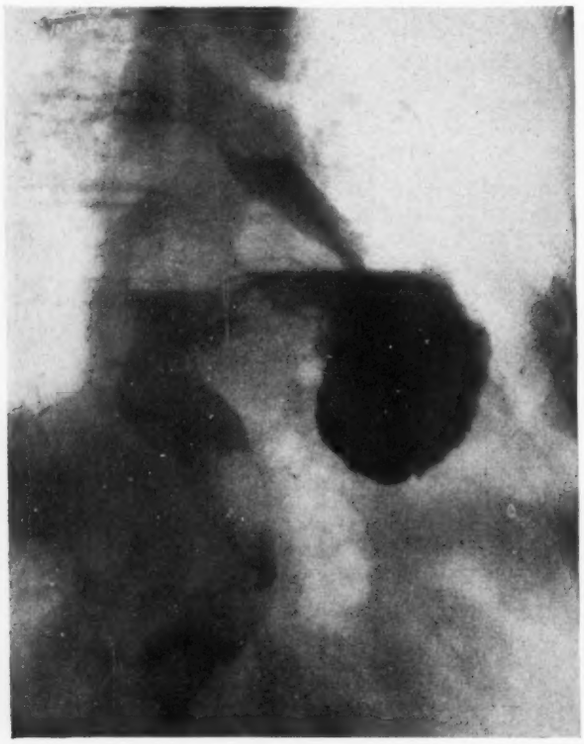

FIG. 4. X-ray of paraesophageal hernia (upside-down stomach) of an eighty year old woman.

FIG. 5. Same case as Figure 4. A considerable part of the splenic flexure is also in the hernial sac.

woman, was admitted to the clinic on October 8, 1955, with the symptoms of incarcerated paraesophageal hernia. X-ray examination revealed the typical "upside-down stomach." At operation it was found that a segment of transverse colon was also included in the contents of the hernia. The patient recovered without postoperative complications. (Figs. 4 to 6.)

Another opportunity for gastropexy as the method of choice is presented when a hiatus hernia is accidentally discovered before or during an intra-abdominal procedure carried out for a different reason. The following case serves as an example:

A sixty-two year old man complained of gastric distress. During roentgenologic examination carcinoma of the antrum and a middle-sized paraesophageal hernia were revealed. A Billroth II procedure was performed and the remaining gastric stump was attached. Contrast medium examination twelve months later failed to reveal relapse of the hernia. (Figs. 7 and 8.)

FIG. 6. Same case as Figures 4 and 5, postoperatively.

FIG. 7. Paraesophageal hernia and cancer of the prepyloric region.

FIG. 8. Same case as Figure 7. Postoperative picture, following partial gastrectomy and gastropexy of the herniated part of the fundus.

These findings would suggest that gastropexy alone may be used in relieving paraesophageal hernias in those cases in which extensive abdominal surgery is undertaken for other reasons, its use being directed primarily toward preventing subsequent complications.

SUMMARY

It is proposed that a procedure such as gastropexy, due to its technical simplicity, may under specific circumstances be used alone for the purpose of relieving hiatus hernias.

ADDENDUM

Since the writing of this article, three other patients with sliding hiatus hernia have been treated surgically. The patients suffered from repeated hemorrhages. The mechanical effect of the operation was excellent. Gastric hemorrhage has not yet reappeared.

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Stainless Steel Cranioplasty

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IN 1944, it occurred to us (M. S. and H. T. W.) that 18-8 stainless steel, used for many years by Babcock[1] and others as suture material and by orthopedic surgeons for bone plates, might prove just as satisfactory as tantalum for cranioplasty and cost considerably less. Accordingly, experiments with this material were done on dogs and the results published in 1946.[2] In these animals, the reaction following stainless steel cranioplasty compared favorably with that reported after the use of tantalum. Moreover, since stainless steel was readily obtainable and easily cut and shaped at the operating table and since the price, at that time, of a stainless steel plate (6 by 6 inches) was approximately $\frac{1}{300}$ that of a similar plate of tantalum (ten cents versus approximately $30.00), we suggested that stainless steel be given a thorough clinical trial.*

In 1951, we published satisfactory results with this material in twenty-two cranioplasties in humans.[3]

There have been few reports by others on stainless steel cranioplasty. In 1951, Adelstein[4] stated that he had used this material in thirteen cases (three plates had been inserted in 1944). No plates had been removed and he found the material satisfactory. He does not describe the type of stainless steel used.

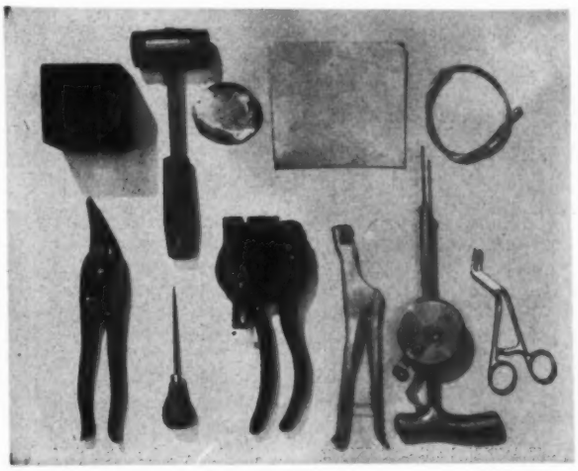


FIG. 1. Tools and materials used in shaping stainless steel plate during operation. Upper row (left to right): hard wood block with concave surface, hammer, preformed stainless steel plate which can be cut to exact size at operation, stock 0.018 inch stainless steel plate from which any shape can be made at operation and No. 30 stainless steel wire. Lower row (left to right): double-action aviation shears, awl or scriber, Whitney double-action plate punch (these three tools can be bought in any hardware store), Cone bone punch (optional), hand drill and Adson bone-holding forceps.

Jaeger inserted a larger stainless steel plate following the removal of a meningioma. He noted no complications five years later.[3]

Boldrey[5] has found stainless steel mesh of value in small defects.

This present report deals with twenty-four

* It is important to order type 316 No. 18-8 Mo (1.75–2.50) stainless steel. This contains roughly 16 to 18 per cent chromium and 10 to 14 per cent nickel and is fortified by molybdenum. We have used the 0.015 inch to 0.018 inch thickness and prefer the smooth finish made by the United States Steel Company. We now use the 0.018 inch thickness because it is standard stock. It is obvious that if these plates are ordered from a surgical supply house, the price may compare somewhat with that of tantalum. The stainless steel should be obtained in lengths of 2 or 3 feet (60.96 to 91.44 cm.) from a reputable dealer in stainless steel. The price of the material when bought in such a manner is very low as compared with that of tantalum or methyl-methacrylate cranioplasty kits. Tantalum is $1.36 a square inch, methyl-methacrylate (according to Spence) is 25 cents a square inch and stainless steel is $\frac{1}{2}$ cent a square inch. We have found stainless steel buttons satisfactory for small trephine defects in the frontal bone.

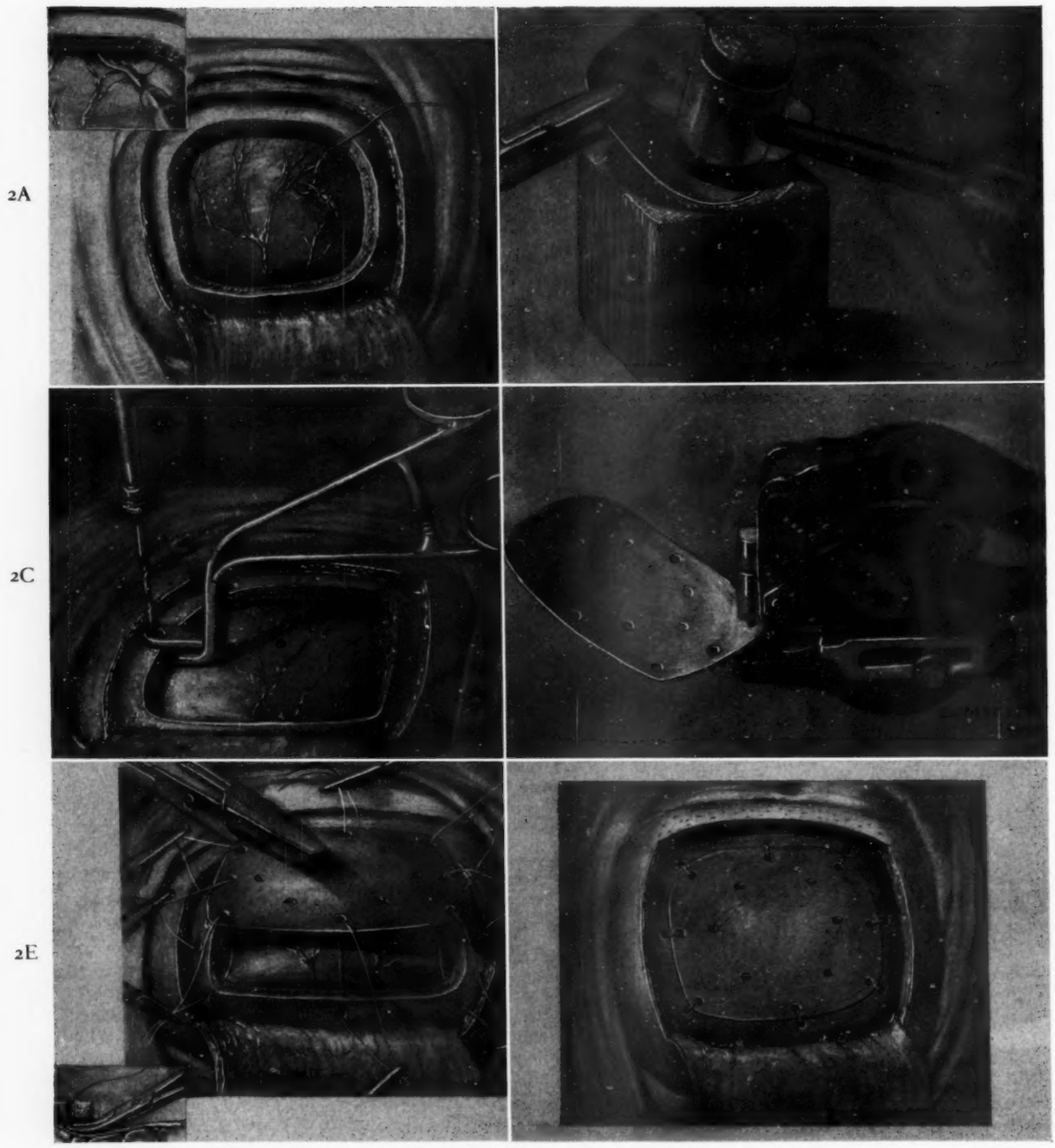


Fig. 2. Technic of stainless steel cranioplasty (see text).

additional cranioplasties and a follow-up on our entire group of forty-six cases.

TECHNIC

The tools and material are shown in Figure 1. The technic is a modification of Gardner's procedure for tantalum cranioplasty.[6] In most instances, the plates were prepared directly in the operating room without preliminary fittings. Those for the frontal sinuses were always pre-formed. Plates were never inserted when infection was present or within six months after the infection had occurred.

The edges of the skull defect should be freed from the dura. (Fig. 2A.) Although dural defects should be repaired either by suture,

aponeurotic or fascial graft or by accepted dural substitutes, this is not always essential. In some cases, large dural defects following removal of a meningioma were not repaired and there were no complications. A membrane enveloping the plate eventually closed the dural defect.

The edges of the bone may be beveled to permit the plate to lie flush with the outer surface of the skull, but due to the thinness of the plate we have found this unnecessary even in the forehead. An onlay, 5 mm. larger than the size of the skull opening, is entirely satisfactory.

A rough pattern of the defect is made from rubber dam, polyethylene film or cottonoid, allowing approximately 5 mm. of additional width along the edges. One member of the surgical team prepares the operative area while the other fashions and perforates the plate (Fig. 2B), which is cut from the pattern out of a stock piece of 0.018 inch stainless steel with double-action aviation shears. (Fig. 1.) It is hammered to the proper contour against the concave surface of a block of hard wood (Fig. 2B), fitted to the bone opening and trimmed with double-action aviation shears.* The plate is placed in position over the defect and markings are made with a scriber on the bone, 2 to 3 mm. lateral to the plate, and on corresponding points on the plate. Holes are drilled or punched through the bone with a hand drill and an Adson bone-holding forceps or a large Cone punch. (Fig. 2C.)† Corresponding holes are then made in the plate with the Whitney double-action punch. (Figs. 1 and 2D.) Additional perforations are made in the plate to permit future fixation of the metal by ingrowing granulation and scar tissue and, also, to permit any serum to escape from under the plate. A No. 30 stainless steel wire suture is inserted through the hole in the bone down to the dura and delivered by grasping it with a hemostat inserted between the bone and dura. (Fig. 2E, insert.) Sutures are similarly placed through the other bone perforations and inserted through corresponding holes in the plate (Fig. 2E) which is then firmly anchored to the bone by tying the sutures (usually four to eight are adequate). We believe that wire sutures are better than screws which may loosen before the plate is firmly fixed by neomembrane and scar tissue. (Fig. 2F.) The incision is closed in two layers with silk or stainless steel wire sutures, without drainage.

* A sterile metal form in the shape of a calvaria may be used.

† We believe the hand drill, protected by the Adson bone-holding forceps, is preferable to the cranial Cone punch because the latter punches a fixed distance from the bone edge, which is adequate for an inlay graft but too short a distance for an onlay graft. The large Cone punch used for ribs and sternum overcomes this objection. However, the thick lower lip may contuse the dura and underlying cortex when the jaws of the punch are opened for its removal.

TABLE I

INDICATIONS FOR CRANIOPLASTY

Bone removed because of tumor infiltration (all but one plate inserted at primary operation):	
Meningioma	5
Eosinophilic granuloma	2
Epidermoid	2
Bone removed because of depressed fractured skull:	
Plate inserted at primary operation	3
Plate inserted at secondary operation	13
Miscellaneous causes:	
Removal elsewhere of infected bone flap	2
Orbital decompression malignant exophthalmos	1
Pulsating exophthalmos in an infant	2
Defect due to operation for brain abscess	4
Defect due to old decompression for traumatic intracerebral hemorrhage	8
Defect due to decompression for edema of brain	2
Floating bone flap	1
Congenital frontal encephalocele	1

TABLE II

AGE INCIDENCE

Age (yr.)	No. of Cases
1–10	14
10–20	7
20–30	5
30–40	9
40–50	8
50–60	3

The indications for cranioplasty are as follows: (1) protective to avoid injury to the brain and cosmetic if the defect is in the forehead or unsightly and disfiguring in any part of the skull; (2) persistent giddiness or vertigo with or without severe headaches on lowering or raising the head; and (3) persistent and annoying pain or tenderness of scalp due to retraction on edge of bony defect.

The procedure is contraindicated if the following conditions exist: (1) infection; (2) poor blood supply to scalp over defect; (3) atrophy, marked scarring or thinning of scalp

over defect; and (4) asymptomatic small defects (less than 2.5 cm. in diameter) within the hairline, particularly in infants, children, women and sedentary adults.

A summary of the case data of forty-six patients operated upon by the authors is given in Tables I to VIII, inclusive.

TABLE III
LOCATION OF DEFECT

Mid-vertex	1
Mid-forehead	4
Frontal sinus	3
Roof of orbit	1
Lateral orbit	2
Lateral frontal bone	7
Frontoparietal bone	2
Frontotemporal bone	5
Temporal bone	2
Bilateral temporofrontal bone	1
Temporoparietal bone	2
Parietal bone	11
Occipital bone	2
More than half lateral skull	3

TABLE IV
DIAMETER OF DEFECT

Small (3–5 cm.)	14
Medium (5–10 cm.)	14
Large (over 10 cm.)	18

TABLE V
CONDITION OF DURA AT CRANIOPLASTY

Found closed	30
Large defect not repaired (4*):	
Tumor	3
Gunshot wound	1
Small defect repaired (11):	
Galeal graft	1
Suture	10
No note as to condition of dura	1

* A persistent effusion over the plate occurred in one case only.

COMMENTS

We believe that stainless steel (18-8 Mo) is an excellent metal for cranioplasty and has advantages over tantalum, other metals, plastics and bone. (Figs. 3 to 6.)

It is easily obtained and stocked in a craniotomy setup. It can be cut, shaped and punched in the operating room with inexpensive tools bought at a hardware store. Thus, primary plate insertions are facilitated. We have found that stainless steel plates, either 0.015 or 0.018 inch thick, are firm yet malleable. Another advantage of stainless steel over tantalum is the cost. A tantalum plate, 6 inches by 6 inches and 0.020 inch thick, costs $49.00, whereas a plate of stainless steel, 6 by 6 inches and 0.018 inch in thickness, costs only 20 cents ($\frac{1}{245}$ the cost of tantalum at the time of writing).

Although human autogenous bone is excellent for small defects, its use frequently presents a technical problem, and the difficulty of obtaining a firm graft in a large defect is obvious.

TABLE VI
COMPLICATIONS FOLLOWING CRANIOPLASTY

None	27
Effusion over plate (transitory) (15):	
Spontaneous absorption	4
One aspiration	5
Two aspirations	3
More than two aspirations	3
Effusion (persistent for 2 yr.; follow-up 5 yr.)	1
Removal of plate (3):	
Infection of scalp	2
Persistent sinus due to thin scalp	1
Mortality	0

TABLE VII
DURATION OF FOLLOW-UP STUDY
(60 PER CENT FIVE YEARS OR MORE)

No. of Years	No. of Patients
1	6
2	2
3	5
4	5
5	9
6	4
7	5
8	5
9	1
10	3

TABLE VIII
RESULTS

Plates inserted	46
Plates removed	3
Incidence of plate removal	6.5%
Clicking movement of plate	1
Discomfort over plate in extremes of weather	3
Convulsions relieved by cranioplasty	None
Headaches relieved by cranioplasty	1
Vertigo relieved by cranioplasty	1
Cosmetic result:	
Good	37
Fair	6
Poor	3

Heterogeneous bone grafts are a gamble and usually absorb or create irritating foreign body reactions. Although the acrylics and other plastics may be satisfactory from a cosmetic and technical standpoint, we do not favor their use at present because of the following factors: (1) Polyethylene plates are too thick to be applied as an onlay graft and the margins of the bone defect must be beveled for proper

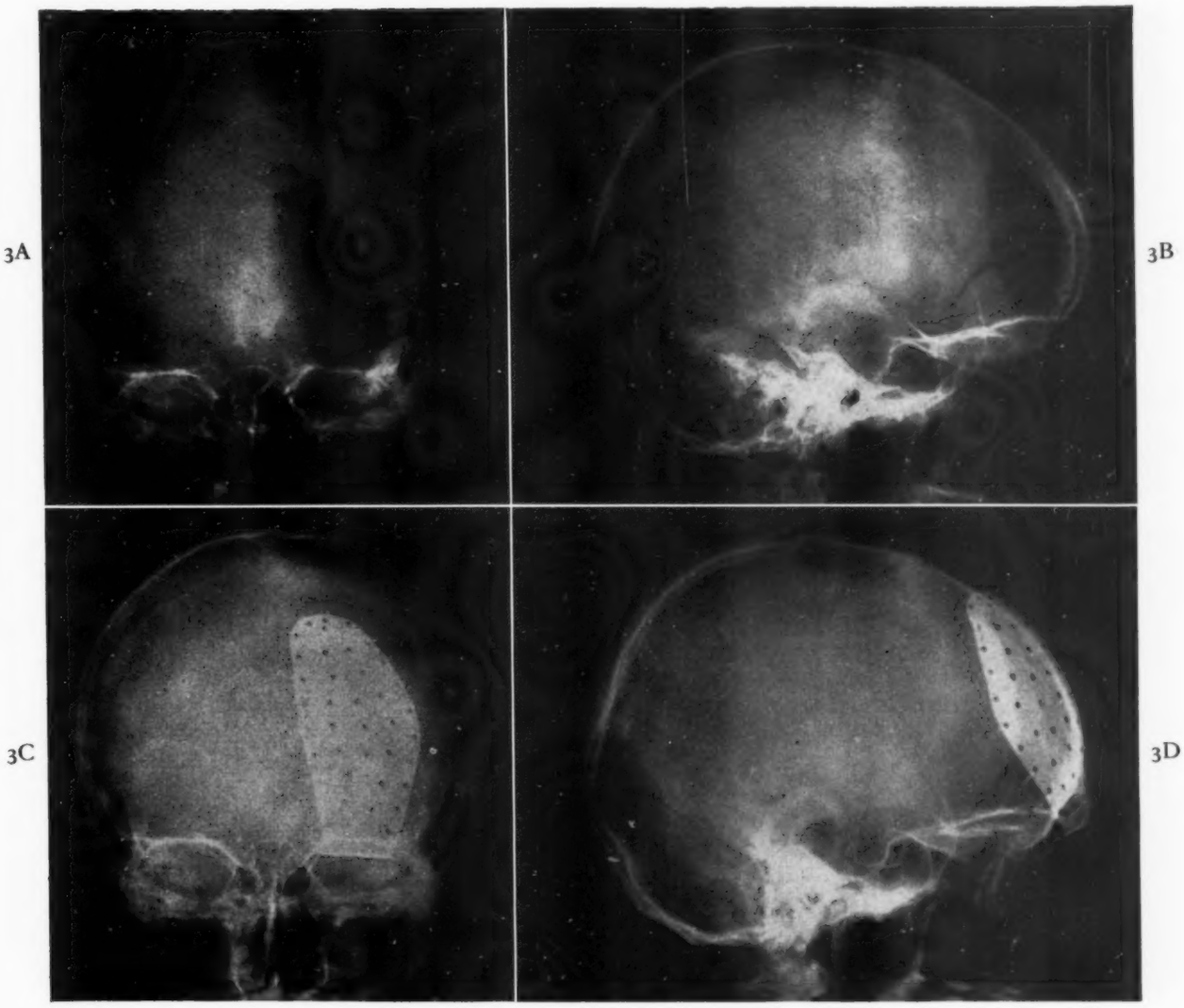
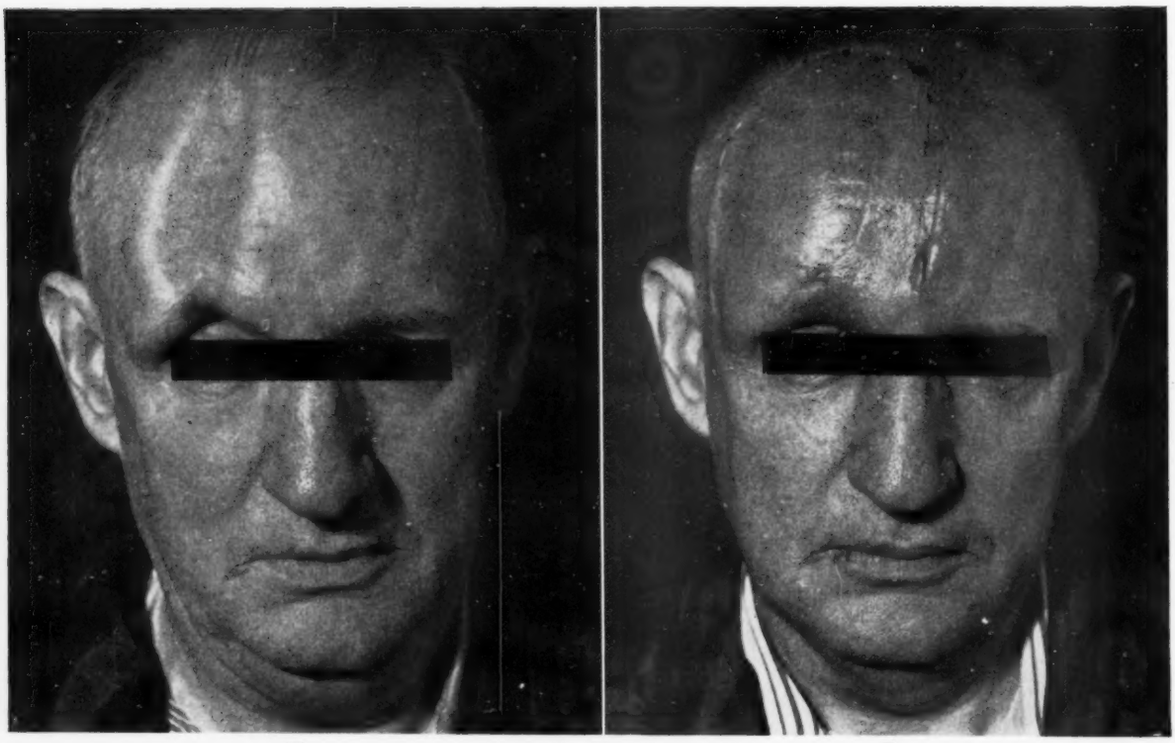


FIG. 3A to D. Cranioplasty involving frontal sinus. Pre-formed plate inserted five months after injury. Patient followed up for three and a half years. No complications.

insertion. Therefore, in old bone defects with thin borders, it is necessary to convert the original bone defect into a much larger one in order to reach bone thick enough to carry a bevel. (2) The lack of uniformity in plastic products is well known. Minute chemical contaminants may cause irritation in tissue. Reliable plastic manufacturers recommend that every batch of material be animal-tested before being used in humans. However, these tests are rarely carried out for more than one week,[7] obviously insufficient time to detect future irritating qualities. (3) Some plastics have been known to lose plasticizer, become brittle and crack completely (this has happened to us following the use of plastic portex tubing). We believe this possible complication may occur later with other plastics. (4) Oppenheimer and his associates[8] have reported an incidence of sarcoma as high as 18 per cent from pure polyethylene and other plastic materials imbedded in rodents. Although we have never heard of such a complication occurring in humans, the possibility exists.

In 1954, Spence[9] reported the use of a polymer of methyl methacrylate in "form-fitting plastic cranioplasty." He states that this material has proved satisfactory and safe in cases followed since 1947. However, in the same article he states that his technic has been changed since 1952 because of lack of sterility of the plastics, many technical factors and



3E 3F

FIG. 3E and F. Same case as Figure 3A to D. Photographs of patient.

excessive heat generated by the plastic. Sterile plastic material, however, is now available. To our knowledge, Spence has not published any case reports or statistics of follow-ups.

He mentions as a favorable point for his plastic that tantalum costs $1.50 or more a square inch, whereas the plastic material only costs about 25 cents a square inch. He makes no mention of the cost of stainless steel although we had reported in 1951 that the stainless steel which we used at that time cost only ten cents a plate (6 inches by 6 inches) or ¼ of a cent a square inch. A similar stainless steel plate, at this writing, costs 20 cents, approximately ½ cent a square inch or 1/50 the price of a plastic plate.

Our experience with cranioplasty involving the frontal sinus is limited to three cases. One plate was inserted immediately following the débridement of a compound fracture. There were no immediate or late complications (two-year follow-up). The other plates were inserted five months and two years after the injury, respectively, and there have been no complications during a follow-up period of three and a half years and one year, respectively. The cosmetic result was satisfactory in all three patients.

Our incidence of plate removal (6.5 per cent) is lower than that reported by Lewin et al.[10] in a series of 128 tantalum cranioplasties (8 per cent). However, tantalum plates were inserted by many operators under trying war conditions and the incidence of plate removal would probably be similar to stainless steel in civilian life.

White[11] found, in reviewing the records of Army hospitals, that the complications from plates made of tantalum, vitallium,® or lucite occurred in practically the same proportion of cases.

We agree with the following conclusions reached by White, based on his review by questionnaire of case reports of 151 late complications following insertion of plates of tantalum, vitallium and acrylic resin which were used in military hospitals during the second World War.[11] (1) Thin-scarred and inadequately vascularized scalp is likely to break down. (2) Poorly fitting plates may slip or erode through the scalp. Triangle metal points for fastening plates have been the most frequent cause. Vitallium and tantalum screws

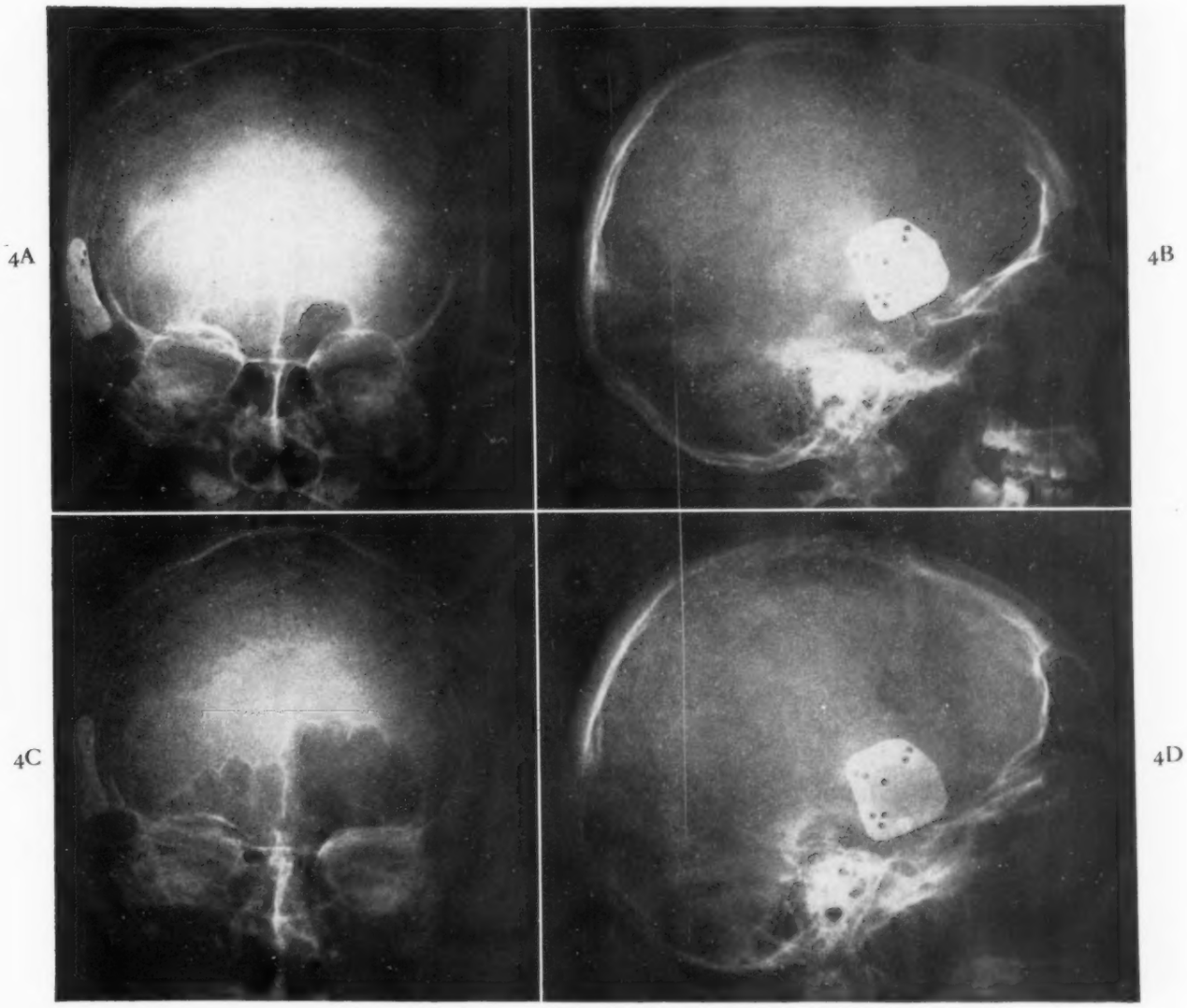


FIG. 4. Follow-up x-rays of skull seven years after insertion of a stainless steel plate in a ten year old child for a defect secondary to epidural hematoma. A and B, immediately after insertion of plate (1947). C and D, seven years later, patient at age of seventeen. No change in position of plate or size of bone defect. The increase in size of frontal sinus is interesting. Patient is asymptomatic.

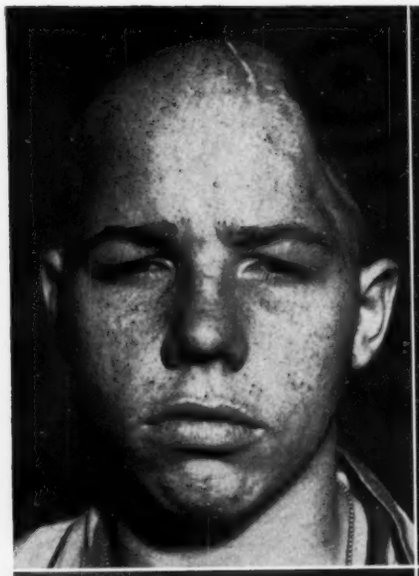
are better, but even these can work loose. (We, therefore, prefer wire sutures.) (3) Plates should be perforated. (4) The dura should be closed tightly, if possible. (5) A plate over the frontal sinus or mastoid process may lead to trouble. (6) A safe, simple and satisfactory repair of large cranial defects can be accomplished better and with no greater risk with an alloplastic plate (metal or acrylic resin) than with grafts of cartilage or bone.

SUMMARY

1. The authors' experimental observations in animals and clinical results obtained in this series of forty-six stainless steel cranioplasties in humans (twenty-seven followed up five years or more) show that this metal is as satisfactory as tantalum or any other metal or plastic for the repair of cranial defects.

2. Since stainless steel can be cut and fitted at the operating table as easily as tantalum and since, at the present writing, the price of a tantalum plate 6 by 6 inches and 0.020 inch thick is $49.00 as compared with approximately 20 cents for a similar plate of stainless steel, the authors conclude that the use of tantalum for cranioplasties is wasteful and should be abandoned unless the price of this

5A



5B

5C

5D

FIG. 5A to D. Bone flap removed because of subdural abscess at age of four. Subsequent intractable right-sided Jacksonian convulsions. Cranioplasty eleven years later at age of fifteen because of frequent head injuries. Patient followed up for six years. Plate satisfactory, cosmetic result fair. No improvement in convulsions.

5E

5F

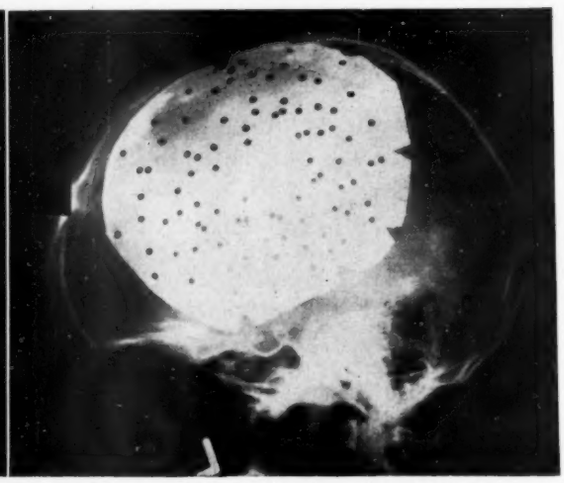


FIG. 5E and F. Same case as Figure 5A to D. X-rays of skull after insertion of plate.

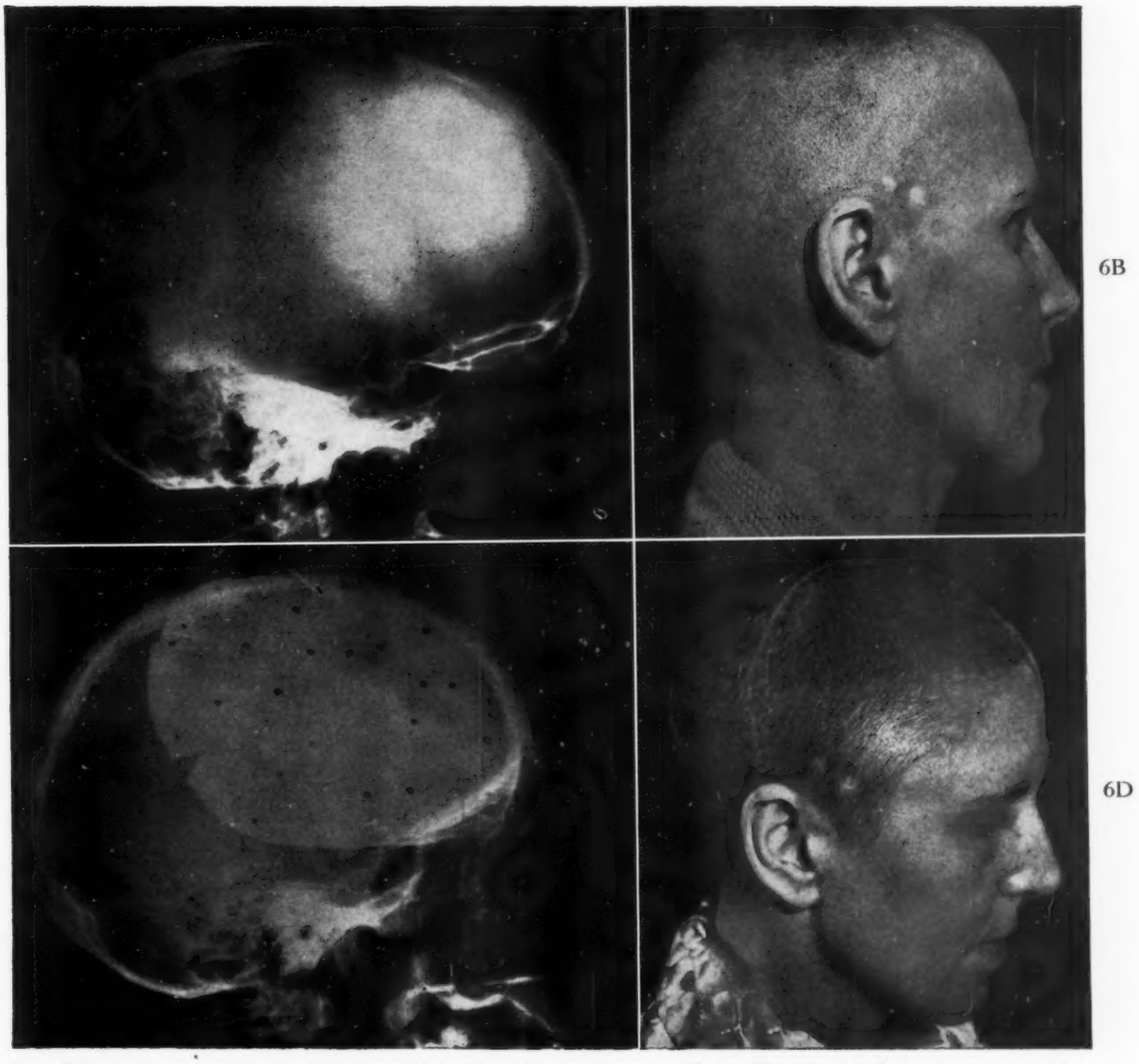


FIG. 6. Large hyperostotic meningioma of right frontal temporoparietal bone. Plate inserted at primary operation following removal of involved bone and large segment of dura. No dural replacements. Persistent effusion under scalp for two years; none since. Total follow-up, five years.

material favorably approaches that of stainless steel.

3. The various plastics, including polyethylene plate and the molding process with methyl methacrylate, have shown no advantage over stainless steel when compared with it to tissue reaction, firmness, malleability, availability, cost, adaptability for primary insertion and long-term follow-up.

The technic of molded methyl methacrylate is more complicated and introduces more problems than the technic of stainless steel cranioplasty (sterility of material, tremendous heat production with possible burns to operator and cranial tissues, curling of edges, retention of air bubbles in material and excessively thin edges for fixation to bone).

The cost of a stainless steel plate is $\frac{1}{50}$ that of a molded methyl methacrylate plate ($\frac{1}{2}$ cent a square inch versus 25 cents a square inch).

Thick polyethylene plates cannot be used as onlay grafts but must be inserted as inlay grafts against bevels to prevent falling through the defect. Most old bone defects have a very thin inner border of bone and it is necessary to

convert a small bone defect into a larger one in order to reach bone thick enough to bevel and hold the plate.

Although polyethylene, methyl methacrylate and other plastics present advantages such as less resistance to x-rays and less interference with electroencephalographic studies, the disadvantages mentioned previously, together with potential sarcogenic drying and cracking possibilities in the plastics, suggest that at present plastics should be used with caution until adequate favorable follow-up studies are available in cases already treated.

We, therefore, believe that at present stainless steel is the best material for alloplastic cranioplasty.

ADDENDA

Since completion of this paper, six cranioplasties have been performed, raising the total to fifty-four cases.

Bering et al.[12] have confirmed Oppenheimer's observations on the sarcogenic property of pure polyethylene film. They report a 12.5 per cent evidence of fibrosarcomas in rats following implantation of such film either subcutaneously in the abdominal wall or under the scalp over cranial defects.

Jackson and Hoffman[13] recently reported a case in which a large methyl methacrylate plate fractured in three places and lacerated the dura following a minor blow to the head. They caution against the use of such plates to cover large skull defects.

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Plastic Reconstructive Surgery after Total Loss of the Penis

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PLASTIC reconstruction of the penis has been described by various authors. Some workers have utilized abdominal tube flaps attached to the penile stump in staged operations and reinforced with rib cartilage.[1–3] Others have raised the phallic tube from the scrotum.[4,5] Procedures for the creation of a new urethral channel include the use of: (1) split-thickness tube grafts, (2) tubed pedicle flaps developed from the scrotum and arm, and (3) skin from the new penis. Except for the work by the Russians during World War II,[2] most of these reports have dealt with observations of one or two cases.

From January, 1945 to December, 1955, twenty-two cases of complete penile amputation were seen in Bellevue Hospital, New York City. The amputation was self-inflicted in two cases and was performed for cancer of the penis in twenty cases. Although sixteen of these men were younger than sixty years of age, reconstruction of the penis was performed in only six.

Some surgeons desist from performing such reconstructive surgery after loss of the penis for the following reasons: (1) The anticipated shortened life span of the patient with advanced cancer of the penis makes a multiple-stage operation impractical. (2) The technical difficulties and complications in the creation of a new urethra are manifold. (3) The elderly age of some patients lessens the desire for a substitute sexual organ. (4) The new phallus may be nothing more than a mere appendage devoid of any sexual function.

We will report herein our experience with surgical reconstruction of the penis and its end results as observed in five patients admitted to the Urology Service, Fourth Surgical Division, Bellevue Hospital. Operative technics adapted from previous publications were followed. The reconstruction was performed not only for cosmetic reasons but also to provide the patient with a sexual organ satisfactory to himself and his sexual partner. Except in one case, no attempts were made to create a new urethra.

TECHNICS OF RECONSTRUCTION

The following operative technics were utilized: (1) migrating tubed pedicle methods and (2) scrotal tubed pedicle method. At present we prefer the second procedure because it is simpler and requires less time for completion. The cosmetic appearance of the reconstructed organ is slightly inferior to that obtained when the first method is used because of the corrugated character of scrotal skin. However, the functional result is equally satisfactory in either method.

Migrating Tubed Pedicle Method. The first stage consists of the construction of a tubed pedicle on the anterolateral aspect of the thigh. This site is utilized in preference to the abdomen as described in other reports because it is not usually molested during the preceding radical groin dissections required by most patients with penile cancer. Two parallel incisions about 5 cm. apart are made, starting just below the level of the anterior-superior iliac spine and continuing downward to the anterior aspect of the mid-thigh. (Fig. 1.) The incisions are deepened through the skin and subcutaneous fat down to the fascia lata. By undermining the tissue between the incisions, a flap is freed which remains attached at both ends.

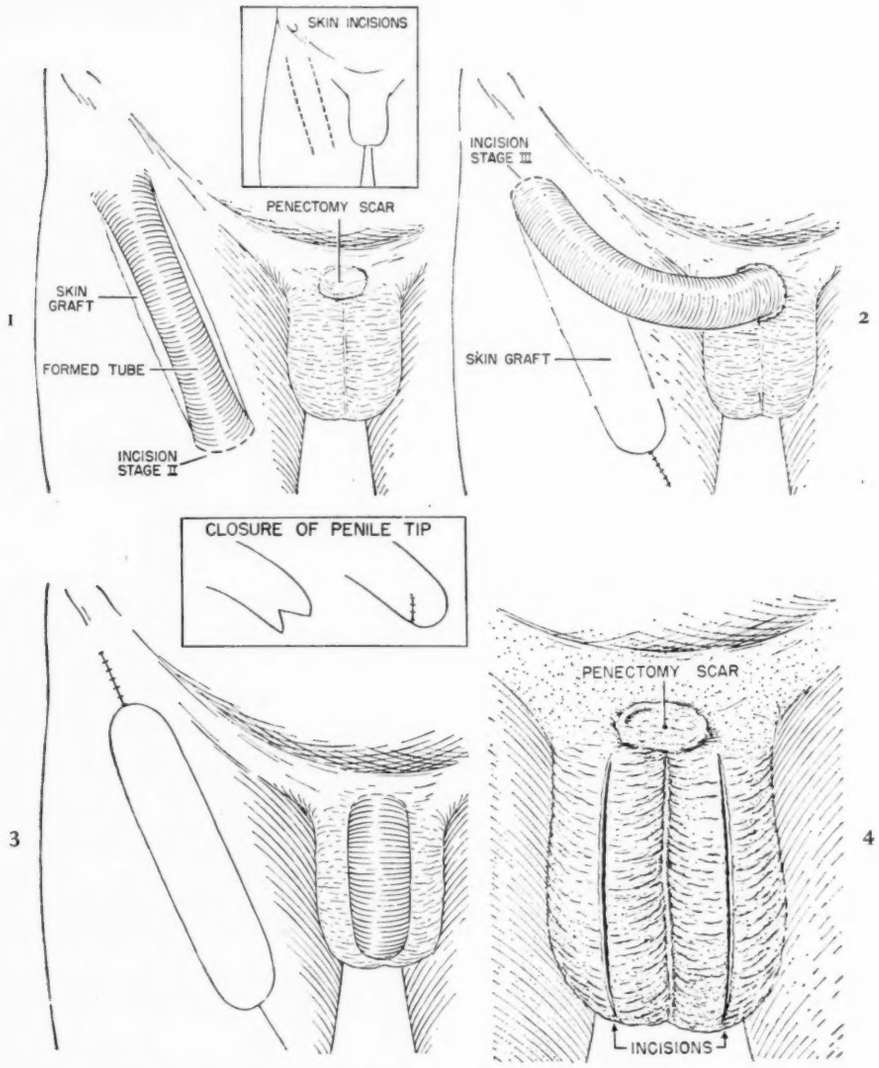


FIG. 1. Migrating tubed pedicle method of phalloplasty. First stage. A tubed pedicle is constructed at the anterolateral aspect of the thigh.

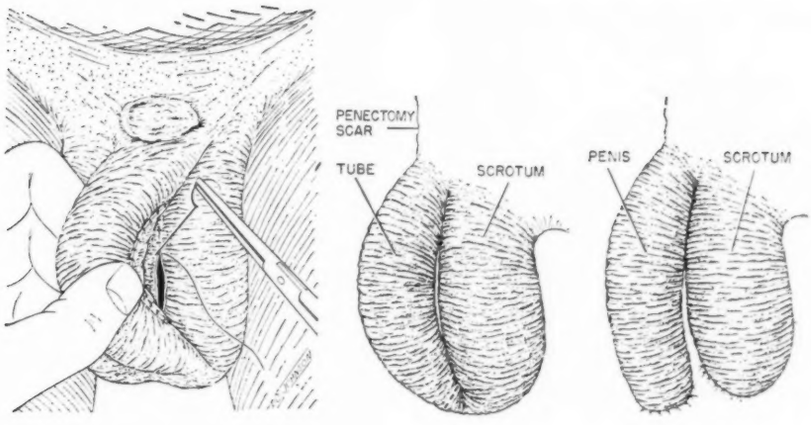
FIG. 2. Migrating tubed pedicle method of phalloplasty. Second stage. The lower end of the tubed pedicle is transplanted to the pubic region.

FIG. 3. Migrating tubed pedicle method of phalloplasty. Third stage. The upper pedicle of the tube is detached and revised to form the distal end of the new phallus.

FIG. 4. Skin incisions in the scrotal tube pedicle method of phalloplasty.

A tube is then formed from the dissected flap by suturing its edges together with interrupted silk sutures, so that it resembles a "suitcase handle." The skin defect which remains on the thigh after dissection of the flap may be closed by undermining the surrounding skin to permit approximation or it may be covered with a split-thickness graft obtained from the opposite thigh with a Padgett-Hood dermatome.

In the second stage of the operation, which is not performed until three or four weeks after the first stage, the lower end of the tubed pedicle is transplanted to the pubic region. (Fig. 2.) Frumkin advised "conditioning" of the flap several days before the second operation by tying a rubber band around the end of the pedicle to be transplanted and leaving it in place for increasing lengths of time up to fifteen hours. In the absence of blanching or lowered skin temperature the flap may be



5 6 7

FIG. 5. Construction of the scrotal penile tube.

FIG. 6. The completed scrotal tubed pedicle.

FIG. 7. The distal end of the pedicle has been divided from its scrotal attachment and revised to simulate the appearance of a glans penis.

safely transferred. The lower pedicle of the tube is freed from its thigh attachment by an oval incision and the resulting defect on the thigh is closed by undermining and approximating the skin edges with interrupted silk sutures. A circular area of skin corresponding in size to that of the pedicle transplant is then excised from the pubic region. The detached end of the tube is now sutured to its new attachment.

The final stage is completed approximately four weeks later and consists of detaching the upper pedicle of the tube and its revision to form the distal end of the new phallus. (Fig. 3.) Before the pedicle is severed, the adequacy of the blood supply is ascertained by observing the "conditioning" procedure previously mentioned. After closing the skin defect on the thigh following the detachment of the pedicle, the new penis is trimmed to the desired length. The distal end is fashioned into two flaps which are then approximated with silk sutures in a manner similar to the closure of an amputated extremity.

Scrotal Tubed Pedicle Method. The first stage consists of the development of a tubed pedicle from the anterior surface of the scrotum. As much of the scrotum as possible is utilized, leaving only enough scrotal skin to cover the testicles. The penile tube is constructed by making two parallel incisions from the pubic region down through the entire length of the scrotal sac. (Fig. 4.) These incisions are deepened through the skin and underlying layers of the scrotal wall except the tunica which is left intact. A flap, attached at both ends, is formed between the two incisions by undercutting the intervening segment of scrotum. The edges of the flap are then sutured together to form a tube and the denuded area beneath is closed by approximating the surrounding skin with interrupted silk sutures. (Figs. 5 and 6.)

The second stage is performed four weeks later and consists of dividing the distal end of the phallic tube from its scrotal attachment. (Fig. 7.) Plastic revision of the free end of the tube is carried out to simulate as much as possible the appearance of the glans penis. The resulting skin defect after detachment of the lower pedicle is closed with interrupted silk sutures.

CASE REPORTS

CASE 1. G. V. (Bellevue Hospital No. 15658-53), a fifty-three year old man, underwent radical amputation of the penis and perineal urethrostomy on April 30, 1953. Histopathologic diagnosis was squamous cell carcinoma of the penis. Bilateral groin dissection was performed in two stages, the left side at the time the penis was amputated and the right side on May 28th. No tumor was found in the specimens removed from the groins.

Plastic reconstruction of a new penis was begun on May 7th by developing a tubed pedicle on the lateral aspect of the left thigh.

8A

8B

FIG. 8. Case 1. The patient was a fifty-three year old man who underwent radical penile amputation for cancer. A, tube graft has been formed and transferred to the pubic region. B, the newly formed phallus.

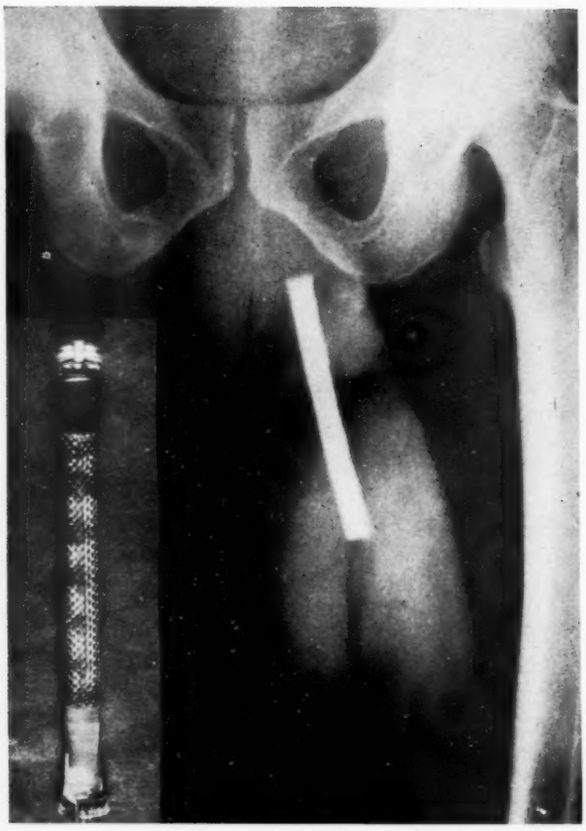


FIG. 9. Roentgenogram showing the metal component of the acrylic implant in the penis. Insert shows the plastic appliance before its insertion.

The lower pedicle of the tube graft was transferred to the pubic region on February 11, 1954 (Fig. 8A) and the upper pedicle detached from the thigh on March 18th. (Fig. 8B.) On April 6th a plastic rod was inserted into the phallic tube through an incision at the penoscrotal junction. (Fig. 9.) The implant was made of acrylic material reinforced with a steel mesh and was intended to serve as a splint for the new penis in much the same manner that rib cartilage transplants have been used for this purpose by others.

The patient returned periodically to the outpatient clinic and reported that he was able to consummate the sexual act, achieving orgasms and ejaculations. Urination was performed through a perineal urethrostomy without difficulty. The plastic splint, however, was extruded spontaneously from the distal end of the penis two months after the patient's discharge from the hospital. The absence of the splint did not impair the patient's sexual ability since the penis apparently had enough rigidity to permit continued intromissions.

CASE II. A. S. (Bellevue Hospital No. 12504-54), a thirty-four year old man, underwent radical penectomy and perineal urethrostomy on March 11, 1954. Histopathologic diagnosis was squamous cell carcinoma of the penis. A radical groin dissection was performed on the right side on March 18th and on the left on April 6th. No tumor was found in the specimens removed during the groin dissection.

A tubed pedicle was raised from the scrotum on April 22nd. (Fig. 10A.) The lower end of the pedicle was detached from the scrotum and the distal end of the new penile tube revised on May 18th. (Fig. 10B.) At the same time, a plastic splint was inserted through an incision at the penoscrotal junction.

The patient was able to enjoy marital coitus after leaving the hospital. One month later the splint was spontaneously extruded. The unre-

inforced penis, however, remained capable of penetration and the patient's sexual ability was maintained.

Comment. A pseudoerectile state characterized by increased dimension and sufficient firmness to permit coitus can be induced in the reconstructed penis by allowing it to hang in its natural dependent position and thus favor venous engorgement. The penis, however, becomes flaccid whenever it is elevated.

Case III. E. C. (Bellevue Hospital No. 9350-54), a thirty-seven year old man, underwent radical amputation of the penis and perineal urethrostomy on January 13, 1955. Histopathologic performed diagnosis was squamous cell carcinoma. A radical groin dissection was performed in two stages on January 20th and February 10th. No tumor tissue was found in the excised specimens from the groins.

Reconstruction of the penis was begun at the time of the second groin dissection by forming a tubed pedicle from the anterior surface of the scrotum. The lower pedicle was freed from the scrotum on May 18th and the distal end of the new phallus was trimmed and revised to simulate a glans penis.

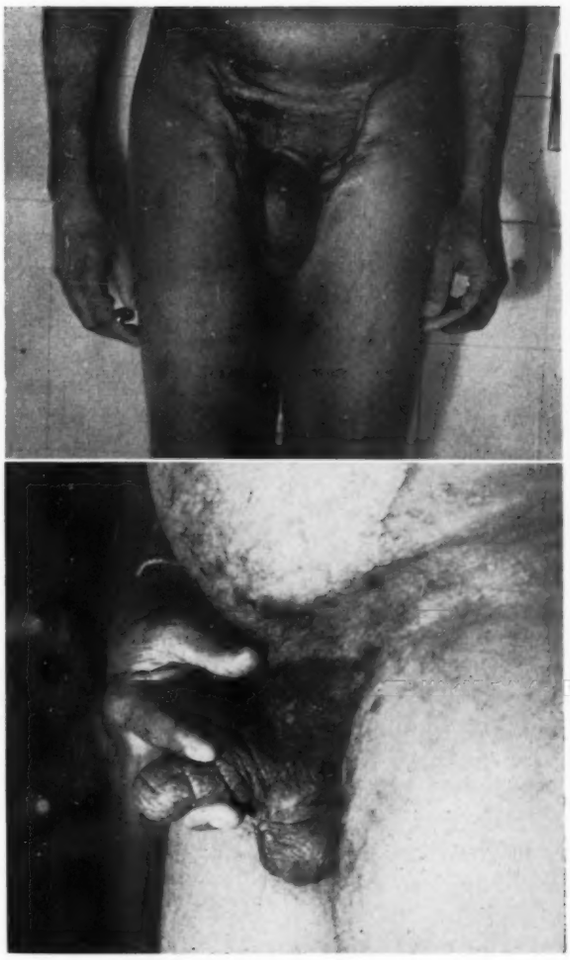
Since his discharge from the hospital the patient has resumed sexual relations which are satisfactory both to himself and his wife.

Case IV. D. H. (Bellevue Hospital No. 64727-54), a fifty-nine year old man, underwent radical penectomy and perineal urethrostomy on December 16, 1954. Histopathologic diagnosis was squamous cell carcinoma of the penis. Right radical groin dissection was carried out on December 30th and left groin dissection was performed on February 3, 1955. No tumor cells were seen in the specimens removed during the groin dissections.

A pedicled tube was elevated from the anterior surface of the scrotum on March 17th. The lower end of the pedicle was detached from the scrotum on April 4th and the distal end of the new penis was trimmed and revised.

The patient's sexual life has been satisfactory since leaving the hospital.

Case V. G. A. (Bellevue Hospital No. 8785-54), a forty-eight year old unmarried man, was brought to the Psychiatric Division of Bellevue Hospital after he had amputated his penis at the base with a razor blade. This act had been performed in a frenzy of conflict over the habit of masturbation.



10A

10B

Fig. 10. Case II. The patient was a thirty-four year old man who underwent radical penectomy for squamous cell carcinoma of the penis. A, a tubed pedicle has been raised from the scrotum. B, the reconstructed penis three months later.

The operative plan was to reconstruct a new phallus and urethra. Accordingly, a perineal urethrostomy was carried out and a tubed pedicle graft elevated from the right thigh on March 5, 1954. Transplantation of the lower pedicle to the pubic region was accomplished on April 21st and the upper pedicle was detached from the thigh on September 2, 1954. Two attempts were made to create a new urethral channel, first by employing a bladder mucosal graft,[6] and second by following the Browne technic for the repair of penoscrotal hypospadias.[7] Both attempts failed, however, due to the development of strictures and fistulas.

The patient now voids through a premanent

perineal urethrostomy and is satisfied with the cosmetic appearance of the new penis. He has experienced nocturnal emissions but has not attempted coitus.

COMMENTS

Total loss of the penis following traumatic or surgical amputation may precipitate serious mental depression. This situation obviously does not stem from a loss of reproductive capacity because spermatogenesis and ejaculation are still present although semen transport is altered. The inconvenience of urinating through a perineal urethrostomy is a predicament overcome without undue difficulty. From the psychologic and esthetic standpoints, the experience undoubtedly can be very traumatic. However, in many instances the patients' plight is primarily concerned with the sexual incapacitation which develops in a man still possessed of normal desires. The depressive reaction often is jointly shared by the wife who may be incapable of adjusting herself to abstinence.

According to Kinsey and his co-workers, the genitalia are not the only structures involved in sexual response.[8] It has long been recognized that there are certain areas of the body which are richly supplied with end organs of touch and which function as erotic zones. Arousal sufficient to effect orgasms can be achieved when these areas are directly stimulated. Evidently the rehabilitated penile amputee may receive erotic satisfaction from the stimulation of other portions of his body in much the same way that some paraplegics are able to achieve orgasms in spite of the absence of genital sensations.

It is also known that erotic sensations are derived not only from tactile stimulation but also from psychologic elements. Inasmuch as the sexuality of these men on the psychic level is usually unaltered, ejaculation and orgasms, which may be weak at first, will approach normal intensity in time.

SUMMARY

Plastic reconstructive surgery after total loss of the penis not only affords the patient the opportunity of continued sex life but also corrects the psychologic, social and esthetic sequelae of such deficiency.

The new penis can be constructed by raising a tubed pedicle graft from the thigh and attaching it to the pubic region in staged operations. A simpler method is to elevate the tube from the scrotum. Creation of a new urethral channel is not necessary and only complicates the procedure.

Experiences with surgical reconstruction of the penis and its end results as observed in five patients are presented. Sexual function was restored in four patients and a fifth patient is still in the hospital. The use of splints is not necessary because a pseudoerectile state, sufficient to permit intromission, is present whenever the penis is allowed to remain in a dependent position.

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Three Cases Illustrating the Value of Transduodenal Approach in Ampullary Obstruction

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OBSTRUCTION of the ampulla of Vater is not an uncommon lesion. It is frequently due to impaction of a gallstone during an attack of cholecystitis and cholelithiasis. Such impaction, however, may also occur after cholecystectomy because of oversight of a common duct calculus during operation and, more rarely, after operation. Such instances have been ascribed to dislodgement of "liver stones" from the intrahepatic bile ducts, liberated by manipulation during or after operation.[1] Benign stricture of extrahepatic bile ducts is most commonly due to operative trauma. The literature is replete with reports of such cases and technic to correct the damage.[2–5] Cattell reported 129 cases of stricture of biliary ducts. Of these, ninety-nine were due to operative injuries, eleven to cholangitis, nine to fibrosis of the ampulla, two to adhesions, one to trauma and one unknown. This subject is not the object of this paper.

Henley[6] has recently demonstrated the retroduodenal artery of Wilkie and its irregular origin by injection methods. It is his contention that operative injury to this artery may cause necrosis or, in some instances, subsequent fibrotic obliteration of the common bile duct and ampulla.

Primary carcinoma of the ampulla cannot be clinically distinguished from carcinoma of the common bile duct at different levels and, in some cases, from carcinoma of the head of the pancreas because of compression or infiltration by the tumor in the region of the pancreaticoduodenal region. These may produce the same symptoms.

Benign tumors originating in the ampulla are a rare occurrence. Christopher[7] reviewed forty-one cases from the literature, and reported one case of adenoma. All occurred in middle-aged and older patients who presented symptoms of biliary obstruction. The tumors included were adenomas, fibromas, neurofibromas, lipomas, papillomas, lymphangiomas, melanomas and carcinoids. Marshall[8] reported four benign tumors of the extrahepatic ducts of 22,000 operations upon the biliary system at the Mayo Clinic from 1910 to 1930. In the same paper he also reported forty-nine cases of primary carcinoma of the extrahepatic bile ducts, among which were fifteen cases of carcinoma originating in the ampulla of Vater. Gray and Sharpe[9] reported 464 cases of carcinoma arising in the extrahepatic biliary ducts at different levels. Of these, fifty-four involved the ampulla.

A definitive diagnosis in most cases of occlusion of the ampulla can be made only by direct examination at operation or post mortem.

The combination of bleeding and obstruction at the terminus of the common duct was a clue to the diagnosis in one of Hunt's cases.[10] Dr. M. K. Smith, in the discussion of that paper, cited a similar case in which he obtained bloody duodenal contents upon aspiration.[10] In cases of ampullary carcinoma, the possibility of detecting malignant cells in aspirated duodenal washings by the Papanicolaou method should be considered. Their presence is doubtful, however, because the enzymes in the duodenum are active and could easily digest the desquamated cells.

In completely obstructive extrahepatic jaundice, the diagnosis can be confirmed by a positive van den Bergh test, the disappearance of urobilinogen from the urine, and increased level of bilirubin in serum and the urine. All other liver tests are equivocal and may be considered as additional evidence for diagnosis.

In January, 1955, Sir Heneage Ogilvie pointed out an important sign in the diagnosis of ampullary carcinoma described by Dr. A. M. Thomas, a pathologist in the Masonic Hospital, London. This is the presence of so-called "silver stool," resembling aluminum paste. It is the result of upper intestinal oozing of blood and the admixture of acholic stool. It is believed to be a new important diagnostic sign in ulcerating ampullary cancer, and has been found to be positive in four cases.[11]

The differential diagnosis may not be simple. A "silent gallstone" lodged in the terminal portion of the common duct or an inflammatory stricture, from previous choledochitis, cannot always be clinically distinguished from malignancy. If complete obstruction supervenes, distention of the gallbladder usually results (Courvoisier's law). However, this phenomenon does not occur when the gallbladder is the seat of chronic inflammation or is surrounded by adhesions.

Roentgen examination in the majority of these patients is of little help, except when filling defects are found in the posterior wall of the duodenum.[12] On the other hand, enlargement of the duodenal U in cancer of the pancreatic head or pancreatitis, or both, is a well known roentgenologic sign and may be informative.

Tests for increased pressure within the biliary tract and gallbladder are of great value, as demonstrated by Mallet-Guy[13] and Caroli.[14]

At operation, determination of intrabiliary pressure, followed by cholangiograms made through the same needles, may be helpful in determining the type and level of obstruction.

Transduodenal exposure of the papilla will remain an important procedure in some cases for final diagnosis and definitive treatment.

Ampullary cancer in early cases may be cured by wide excision of the adjacent duodenal wall, including the distal end of the common and pancreatic ducts with reimplantation of the ducts. This comparatively safe procedure is indicated, if the lesion is still local, in elderly patients, those who are deeply jaundiced, or weak or have a cardiac condition.

Fruchaud's method[15] for mobilization of the duodenum is an important advance over Kocher's procedure. With this improved technic, the subserous mobilization of the duodenum keeps the duodenal blood supply intact. This modification of Kocher's method will eventually become widely recognized for gastroduodenal and biliary surgery.

In the following three cases of obstruction of the ampulla of Vater, after a relatively short period of time following cholecystectomy, silent progressive obstructive jaundice developed. In each of these cases the obstructive jaundice was due to a different cause.

It is because of the similarity of the clinical picture and the effective use of the transduodenal operative approach that these cases are being reported. Definitive diagnosis and the effective therapy were made possible by a transduodenal surgical approach.

CASE REPORTS

CASE 1. J. G., a forty-four year old white man, was admitted to Misericordia Hospital on June 1, 1950. He was acutely ill with marked abdominal pains, nausea and fever. The abdomen was distended and the liver was slightly enlarged. There was right upper abdominal quadrant rigidity. No masses were palpable, and there was no indication of jaundice. The heart, lungs and blood pressure were normal. Blood count was 18,250 white cells, 82 per cent polymorphonuclear cells. Urinalysis revealed albumin 1 plus and hyaline casts; the presence of bile was not noted. The diagnosis was acute cholecystitis and cholelithiasis.

Laparotomy, performed the next day, revealed an enlarged, indurated and inflamed gallbladder which contained multiple calculi. The bile ducts, on exposure and palpation, contained no calculi. Cholecystectomy was performed and a cigarette drain inserted to the hilum of the liver. The abdomen was closed in layers. Laboratory data revealed that the bile cultures were sterile. Microscopic examination of the gallbladder revealed acute and chronic inflammation. The patient made an uneventful recovery and left the hospital seventeen days later.

The patient was readmitted to the hospital on December 29, 1950, almost seven months after cholecystectomy. He complained of severe abdominal pains, vomited frequently for forty-eight hours and became increasingly jaundiced. After five days all abdominal pain subsided but the jaundice increased progressively.

Laboratory data revealed that the white cell count was 10,000 with 91 per cent polymorphonuclear cells. Icteric index, upon admission, was 25 units and within five days rose to 112

units. Urobilinogen disappeared from the urine and the stools became completely acholic. The clinical diagnosis was extrahepatic biliary obstruction probably due to calculus.

After five days of preparation, laparotomy was performed. The liver was exposed by a right paramedian incision. Fibrous adhesions were severed and the duodenum was mobilized using Kocher's method. A large impacted calculus was palpable in the ampulla. No other stones could be felt in the bile ducts. The anterior duodenal wall, opposite the ampulla, was incised longitudinally; the gallstone, about 1.5 cm. in diameter, was found impacted in the ampulla. Grossly, the pathologic picture resembled a "paraphimosis"; the sphincter was very edematous. The ampulla was incised and the stone extracted. Two individual sutures were placed on either side of the cut of the ampulla to the common duct. The duodenal incision was closed transversely; the abdomen was closed in layers with drainage. The patient made a complete, uneventful recovery and was discharged from the hospital on the seventh postoperative day and has remained well since.

Case II. E. G., a fifty-five year old white housewife, was admitted to Misericordia Hospital on January 14, 1949. She was acutely ill and complained of excruciating epigastric pains and vomiting. Past history revealed she had had recurrent abdominal pain, nausea and vomiting for nineteen years. Oophorectomy and, a few years later, uterine suspension for prolapse had been performed. Physical examination revealed tenderness and rigidity in the right upper quadrant. No masses were palpable, nor was there any evidence of jaundice. Pelvic examination revealed no abnormalities.

Laboratory examination revealed that the urine and stool were normal. Blood count revealed leukocytosis. Graham test demonstrated non-filling gallbladder. The preoperative diagnosis was acute cholecystitis and cholelithiasis.

The next day at laparotomy a markedly indurated, inflamed gallbladder containing multiple calculi was revealed. The bile ducts were inspected and palpated and found to contain no calculi. Cholecystectomy was performed, as well as appendectomy. A cigarette drain was inserted to the hilum of the liver and the abdomen was closed in layers. The patient made an uneventful recovery and was soon discharged.

Second admission to Misericordia Hospital was on June 23, 1952, two and a half years after cholecystectomy. The patient was deeply jaundiced and had only vague pains in the abdomen; no colic was present. There was no tenderness or masses. The liver was slightly enlarged. The patient had lost no weight. Laboratory data revealed the following: red blood count 3,900,000 cells; hemoglobin, 74 per cent; white blood count, 7,000; polymorphonuclear cells, 67 per cent; icteric index, 40 units. The urine contained bile; stools were acholic. The clinical diagnosis was obstructive jaundice due either to calculus or malignancy of the common bile duct. After four days of preparation laparotomy revealed many adhesions, which were carefully dissected, and the duodenum, hepatic and common ducts were exposed. The latter was markedly dilated at its proximal three-fourths. Incision of the dilated supraduodenal portion of the common duct evacuated a large amount of "muddy bile." No gallstones were found in the extrahepatic bile ducts. However, the distal fourth of the common bile duct was found to be obstructed. It did not permit the entrance of even the finest probe. Its lumen was constricted, thickened, and formed a fibrous cord as it passed through the head of the pancreas to the duodenum. The pancreas was not indurated. The distal fourth of the common duct, on repeated trials, was found to be completely occluded. The incision in the common duct was slightly elongated and the duodenum incised at its upper knee. Choledochoduodenostomy was performed over an indwelling catheter which was left loosely in place without sutures to be passed spontaneously. The abdomen was closed in the usual way. A Penrose drain was inserted to the hilum of the liver and the abdomen sutured.

The patient was discharged on the ninth postoperative day with free passage of bile. The jaundice cleared up dramatically within a few days. At discharge, the urine was free of bile, the stools were normal and the icteric index had dropped to 8.4 units.

The patient was admitted for a third time to Misericordia Hospital almost one year after the second operation. She complained of epigastric pains, radiating to the back. She was afebrile and not acutely ill. Jaundice was not present and the liver was not enlarged. Gastrointestinal x-ray examination revealed the indwelling catheter *in situ*, within the lumen of

the common duct, extending into the duodenum. It had not been expelled, against expectation. There was tenderness over the site of the tube.

After complete studies and consultations, the consensus was that the presence of the retained indwelling catheter was the cause for her complaint. On June 14, 1952, the old epigastric longitudinal scar was excised and the abdomen opened in line. Many omental adhesions were dissected and severed. The duodenum was isolated. The indwelling catheter could easily be palpated within the duodenum. The anterior wall of the latter was incised and the catheter withdrawn without difficulty. The bile flow into the duodenum was clear and unimpaired. The tube was encrusted with bile salts. The ampulla of Vater was found to be completely obliterated. The communication between the common duct and duodenum via the choledochoduodenostomy was found to be ample and functioning well. The abdomen was closed without drainage. The patient recovered and was discharged on the tenth day. She has remained well since.

Comment: This patient had had no evidence of cholangitis during her first illness of cholecystitis and cholelithiasis to account for the subsequent stenosis of the distal portion of the common duct. The fibrous obliteration of the distal fourth of the common duct may be explained by the recent work of Henley[6] concerning the importance of guarding against injury to Wilkie's retroduodenal artery. The occlusion of this vessel can apparently, in some cases, cause insufficient arterial supply of the delicate wall of the common duct, leading to anemic fibrosis. This artery may be impaired during exposure of the common duct or gastroduodenal resection.

Wilkie's retroduodenal artery shows many variations of origin. It may arise from the superior duodenal, hepatic or cystic artery or even from the inferior pancreaticoduodenal artery.

Henley states that "a knowledge of this vessel is important surgically for where it does not anastomose freely with the inferior pancreaticoduodenal, ligation of the vessel proximally might result in gangrene of terminal part of the duct and a biliary fistula, or may be responsible for the occurrence of bile duct stricture some weeks or months after apparently uncomplicated surgery."

Case III. H. K., a fifty year old white man, was admitted to Misericordia Hospital on November 7, 1950, with signs and symptoms of cholecystitis. He had had a history of coronary disease and was previously (1947) treated by the medical division of the hospital for coronary artery thrombosis with posterior wall infarction, from which he recovered. At that time, upon routine x-ray examination, he was found to have multiple calculi in the gallbladder. There were, however, no clinical symptoms related to the finding.

On November 7, 1950, he was readmitted to the surgical division with a severe attack of cholecystitis. The medical consultant advised cholecystectomy. The patient's heart was compensated and regular; the rate was 68. The abdomen was tender and the gallbladder palpable. There was no jaundice or abdominal rigidity. The temperature was 103°F. The leukocyte count was 22,600, with 98 per cent polymorphonuclear cells.

Cholecystectomy was performed two days after admission. The gallbladder was found to be enlarged, thickened and inflamed, and contained multiple calculi. A large stone was lodged in the neck of the gallbladder. Upon aspiration of the latter, foul-smelling pus was obtained; on examination this revealed Escherichia coli. The common duct, on exposure, was thin, supple, not dilated, contained no calculi and was grossly free from infection. The abdomen was drained and closed. Pathologic report revealed acute and chronic cholecystitis and cholelithiasis. With sulfonamide and antibiotic therapy, the patient made a smooth recovery and was discharged on the tenth postoperative day.

Following cholecystectomy he had had recurrent attacks of chills and fever. The temperature subsided after a few days of antibiotic therapy. At this time the maximum white blood count was 12,000 with 84 per cent polymorphonuclear cells. Blood cultures were negative. No other unusual findings could be elicited. Thereafter he was readmitted several times to the hospital with chills and fever, nausea and vomiting. At no time up to this point was there evidence of jaundice. Antibiotics and sulfonamides repeatedly resulted in subsidence of the chills and fever which occurred intermittently for several months. The icteric index did not exceed 16 units.

In June, 1951, seven months after cholecys-

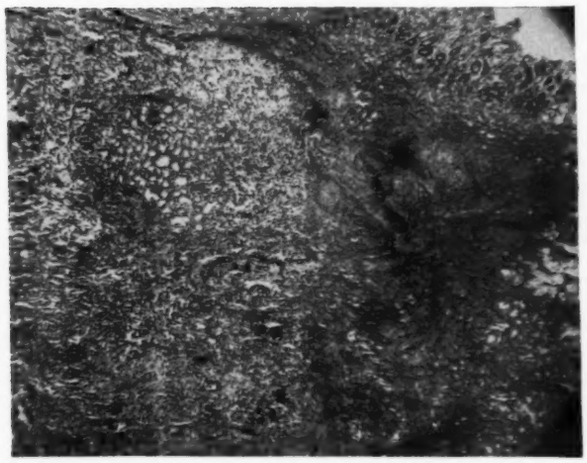

FIG. 1. Adenocarcinoma of papilla of Vater, infiltrated with chronic inflammatory cells (low power field).

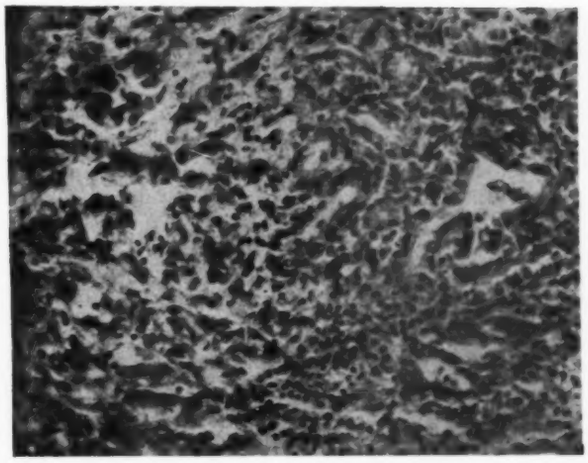

FIG. 2. Adenocarcinoma with foci of chronic inflammatory cells (high power field).

tectomy, in addition to fever, chills, nausea and vomiting, jaundice developed with all the signs of incomplete biliary obstruction and cholangitis. The liver became moderately enlarged; there was no pain, tenderness or abdominal rigidity. The gastrointestinal x-ray examination was not remarkable. The leukocyte count was 7,400. The icteric index rose to 36 units, serum bilirubin to 1.55 mg. per cent. The urine contained bile and urobilinogen. Stools were not acholic. Blood cultures at the height of the temperatures continued to be negative. The tentative diagnosis was extrahepatic biliary obstruction, due either to a calculus or stricture of the common duct.

On the basis of the clinical symptoms and continued indefinite findings, we decided to perform exploratory laparotomy.

On June 14, 1951, the old subcostal abdominal scar was excised and the adhesions dissected. The duodenum and hilum of the liver were exposed. The common duct was dilated, but did not contain stones. The duodenum was mobilized and the pancreas dissected away from the portal vein. Supraduodenal choledochotomy was performed and clear bile exuded from the duct. Probing the duct did not reveal any stones, but an obstruction was encountered at the ampulla of Vater. A No. 8 catheter could not be passed into the ampulla, which was exposed via transverse duodenotomy. The papilla of Vater was inspected and found to be the seat of neoplastic infiltration. The posterior lip of the papilla of Vater especially was thickened and infiltrated. The periampullary area of the duodenum was not infiltrated and there were no obvious metastases in the regional lymph glands. The ampullary and periampullary regions were removed by circumcision with diathermy cautery, including the distal sections of the common and pancreatic ducts. The ducts were implanted into the posterior duodenal wall. It was then easy to flush from the supraduodenal choledochotomy into the duodenum. A No. 12 catheter could then be easily passed through. The supraduodenal incision in the common duct was closed without drainage. The duodenotomy incision in the anterior wall of the duodenum was closed with two layers of interrupted sutures. A Penrose drain was placed in the abdomen extending to the pancreatic area. The abdomen was closed in layers. The patient made an uneventful recovery and no further chills were present five days postoperatively. Jaundice had quickly subsided. The patient left the hospital on the twenty-third day and has remained well for four and a half years.

The pathologic report on June 14, 1951 revealed typical adenocarcinoma, irregular sized and shaped glandular structures and infiltrating bundles of smooth muscular fibers. (Figs. 1 and 2.)

Subsequently the patient's heart improved but five years later, in June, jaundice and melena developed. Reoperation was performed; it was still possible to perform a radical procedure with success. Obstructing cancer of the new papilla, which had recurred, was found. It extended into the duodenum and superficially into the pancreatic head. Resection of the antrum of the stomach, duodenum and

one-third of the pancreas was successful. No metastatic glands were found.

COMMENTS

The present trend in the surgical treatment of carcinoma of the ampulla of Vater is towards Whipple's method of radical block resection of the duodenum, head of pancreas, distal end of the common duct and regional lymph nodes, implantation of the common duct and pancreatic residual into a proximal Roux loop of jejunum.[16] This procedure received wide acceptance but efforts to overcome postoperative complications and morbidities have brought forth many modifications of the original procedure by Whipple,[17] Cattell,[18] Brunschwig,[19] Watson,[20] Child[21] and others. Radical block dissection conforms to the present philosophy of radical extirpation because of the frequent recurrence of cancer of the ampulla.

Berger and Koppelman[22] reviewed 386 cases of carcinoma of the duodenum. Of these, 251 occurred in the periampullary region, seventy-seven in the supra-ampullary region and fifty-eight in the infra-ampullary region. Radical extirpation had been performed upon seventy-six patients with a mortality rate of 31 per cent.

However, when cancer of the papilla or ampulla of Vater is recognized or discovered early, localized in the papilla or ampulla of Vater without involvement of regional lymph nodes, the older conservative transduodenal retroduodenal excision of the ampulla and the terminal bile and pancreatic ducts is still a justifiable operation, especially in deeply jaundiced, elderly, weak and cardiac patients. Many such isolated cured cases have been reported in the literature.[10]

The operative mortality[22] and morbidity rate of pancreaticoduodenectomy, not withstanding frequent recurrences, have caused many surgeons to revert to palliative methods in cases of malignant obstructive jaundice. Cholecystogastrostomy and cholecystoduodenostomy without even extirpating the primary lesion, merely to re-establish continuity of "bile flow," are frequently performed.

The ampulla of Vater, as seen on opening the duodenum, forms a colliculus on the mucosal surface of the posterior duodenal wall where the common and pancreatic duct open into the duodenum. The ductal as well as the duodenal surface of the ampulla may be the place of origin of a malignant tumor, but at both sites there is early obstruction of the lumen. Frequently the tumor presents the consistency of a small elastic ball. It is well known that some of these tumors, which are adenocarcinomas almost without exception, grow more slowly than elsewhere. Some ulcerate early and blood may appear in the gastrointestinal tract.

Booher and Pack[23] reported a case of successful resection fifty-one months after initial local excision of the lesion. However, they are opposed to conservative resection of malignant ampullary tumor and advocate the more radical procedure.

Cattell and Warren[24] reported the case of a slow-growing ampullary carcinoma after primary cholecystojejunostomy for the relief of bile obstruction in which three and a half years after this palliative operation, radical extirpation with resection of the duodenum and pancreatic head still was possible and successful.

In cases amenable to conservative transduodenal local excision of malignant lesions, Wangensteen's principle of a second-look operation is indicated.

The transduodenal surgical approach is indicated as a safe procedure for exposure of the ampulla of Vater for the removal of an impacted calculus in the distal part of the common bile duct or in the ampulla. This is not difficult and is much less serious than to force removal of an impacted calculus from supraduodenal choledochotomy. When an impacted stone is removed from the ampulla via transverse duodenotomy, the procedure is less conducive to secondary traumatic stricture of the common duct. It also obviates the necessity for bile duct drainage when choledochotomy is performed for removal of a calculus. This makes for a shorter postoperative recovery and for fewer subsequent complications.

In the developmental years of gallbladder surgery, Kehr[25] already recognized the disadvantage of protracted drainage of the common duct. A wide open papilla obviates this necessity and furthers speedy recovery.

SUMMARY

1. Three cases of obstruction of the ampulla of Vater are reported due to different causes, namely, ampullary obstruction by a biliary calculus, fibrous stricture of the distal fourth of the common duct and ampulla, and primary early local adenocarcinoma of the ampulla of Vater.

2. All of these cases occurred within a more or less short period after cholecystectomy for cholecystitis and cholelithiasis.

3. Obstructive jaundice developed postoperatively in all patients.

4. The surgical transduodenal approach is advocated for definitive diagnosis and effective therapy. All three patients recovered and are well.

5. The third patient had primary adenocarcinoma, localized at the ampulla of Vater. It was excised with the distal part of the common bile and pancreatic ducts. The patient is alive and well four and a half years postoperatively.

6. We believe that there is a definite place for conservative transduodenal and retroduodenal excision of ampullary carcinoma, when it is localized and without evidence of involvement of the regional lymph nodes. A second-look operation may be indicated to rule out recurrence of the lesion. Radical block dissection can be secondarily performed, because ampullary cancer is less malignant than elsewhere.

7. We explain the cause of stricture of the distal fourth of common duct in the second case as a result of trauma to the retroduodenal artery of Wilkie. This vessel should be identified and preserved.

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Tracheostomy

INDICATIONS AND TECHNIC IN SURGICAL PRACTICE

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IN the two-year period from July, 1953 to July, 1955, tracheostomies were performed on sixty-five patients at the Portland Veterans Administration Hospital. In order to illustrate the various conditions in which tracheostomy may be of value in present day surgical practice, we will review the indications for the operation in these patients.

Tracheostomy is one of the oldest operations in the history of medicine. It is first recorded as having been practiced by Asclepiades in Rome in the 1st century B.C.[3] The operation has traditionally been looked upon as a dramatic emergency procedure to be employed for acute obstruction of the upper air passages. As far back as 1849, however, Hall[6] recommended its use for other conditions including tetanus, hydrophobia, coma and narcotic poisoning. In more recent years, as our understanding of the causes and the physiologic effects of asphyxia has increased, the procedure has been adopted for a wide variety of situations. Tracheostomy should no longer be thought of in terms of managing specific diseases, but rather in terms of correcting the pathologic physiology seen in many medical and surgical conditions.

OBSTRUCTION OF THE UPPER RESPIRATORY TRACT

Any obstructive lesion of the upper respiratory tract threatens life by asphyxia. The chink between the vocal cords is the narrowest portion of the upper respiratory tract and the most common site of obstruction. The causes of the obstruction are legion. Any acute inflammatory disease of the mucosal lining of the larynx may produce sudden obstruction. Inflammatory conditions or abscesses in the neck about the larynx or the base of the tongue also may shut off the airway. Tumors in or about the larynx may obstruct by mechanical pressure or by edema and inflammation about the tumor. Foreign bodies, aspirated food or fluid, or even inhaled noxious fumes may cause obstruction through spasm of the vocal cords and edema of the larynx. Paralysis of both vocal cords may also be a cause of obstruction. Trauma, either accidental or surgical, may obstruct the air passages by means of edema and interstitial hemorrhage.

At times obstruction of the upper respiratory tract is an unexpected rapid development calling for emergency surgery to prevent sudden death. In most cases, however, tracheostomy can and should be a carefully planned, deliberate procedure carried out well before obstruction of the larynx causes any degree of asphyxia.

A total of forty-four tracheostomies were performed to prevent or treat obstruction of the upper respiratory tract. (Table 1.) Of these procedures, thirty-two could be designated as prophylactic tracheostomies since at the time

TABLE 1
TRACHEOSTOMY FOR OBSTRUCTION OF UPPER RESPIRATORY TRACT; INDICATIONS FOR SURGERY IN 44 CASES

Prophylactic Tracheostomy:	
Radical operations for cancer of head and neck	23
Laryngeal operations (excluding total laryngectomy)	7
Pre-radiation therapy	1
Deep cervical abscess plus diabetes	1
Therapeutic Tracheostomy:	
Obstruction due to cancer of head and neck	7
Bilateral vocal cord paralysis (due to intrathoracic cancer)	2
Radiation reaction	1
Stenosis of larynx	1
Deep cervical abscess	1

of operation no degree of obstruction existed. In the remaining twelve patients some obstruction was present at the time of surgery; this varied from very slight inspiratory stridor to almost complete obliteration of the airway with marked respiratory effort and cyanosis.

The majority of the prophylactic tracheostomies were performed at the time of radical surgery for cancer of the head and neck. Surgeons have learned through bitter experience that sudden obstruction of the airway may occur following major operations in the neck, particularly in the suprahyoid region. In most of the so-called combined operations in which intraoral cancer is removed together with half or more of the mandible in continuity with radical neck dissection, a prophylactic tracheostomy must be performed. The tracheostomy serves the dual function of preventing asphyxia from postoperative obstruction of the larynx and of allowing the removal of aspirated saliva and food in the early postoperative period when the patient has not recovered the normal swallowing reflex. In addition to the combined operations, prophylactic tracheostomy may also be indicated with extensive surgery about the base of the tongue or pharyngeal wall.

Many surgeons are familiar with the transient lymphedema of the face, lips and tongue that may occur after bilateral radical neck dissection performed in one or two stages. Failure to realize that a similar degree of edema may also occur in the larynx may at times lead to a sudden postoperative disaster. The safe general rule to observe is that tracheostomy must always be performed at the time of a bilateral neck dissection or a second radical neck dissection. Prophylactic tracheostomy is also mandatory following most operations upon the larynx with the exception of minor procedures carried out through a laryngoscope.

One prophylactic tracheostomy in this series was performed in preparation for radiotherapy directed to the larynx. This patient, a twenty-two year old man, had extensive reticulum cell sarcoma of the larynx with bilateral cervical metastases. Although no obstructive symptoms were present at the time of surgery, complete obstruction of the larynx occurred soon after the start of radiation and persisted for several weeks. In many extensive tumors of the extrinsic or intrinsic larynx obstruction may be expected during the course of radiotherapy. Although a tracheostomy need not be performed before the start of treatment, the patient must be followed up carefully and a tracheostomy performed as soon as impairment of the airway becomes manifest.

Another prophylactic tracheostomy was performed on a patient with a deep cervical abscess. In most instances if no obstruction of the airway exists at the time a cervical abscess is treated, adequate surgical drainage of the abscess will forestall the development of obstructive symptoms. The prophylactic tracheostomy in this case, however, was performed upon a diabetic patient with a large cervical abscess with extensive surrounding inflammatory reaction. Although no obstructive symptoms were present, it was feared they might suddenly appear since the infection was rapidly progressing and was poorly controlled.

The majority of tracheostomies performed as a therapeutic measure for obstruction of the airway in this series were in patients with advanced cancer of the head and neck. Two tracheostomies were performed for bilateral vocal cord paralysis due to intrathoracic tumors. In one patient laryngeal edema developed during radiotherapy for cancer of the larynx, necessitating tracheostomy. The two remaining therapeutic tracheostomies were performed for cicatricial stenosis of the larynx and for laryngeal obstruction associated with a deep cervical abscess.

Emergency tracheostomy performed for advanced obstruction of the airway is often a difficult procedure which must be carried out upon a terrified, struggling patient. There is an ever present danger of cerebral damage from asphyxia as well as of hemorrhage and trauma from the surgery. Whenever possible obstruction of the airway must be detected at an early stage and treated without delay. Restlessness of the patient and even the slightest degree of inspiratory stridor should put the surgeon on guard that laryngeal obstruction may be imminent. Nine of the therapeutic tracheostomies in this series were performed deliberately without stress or tension for obstruction early in its course. The remaining three patients were operated upon as emergencies for acute obstructive symptoms.

OBSTRUCTION OF THE LOWER RESPIRATORY TRACT

All physicians are aware of the dangers and consequences of obstruction of the upper

FIG. 1. Secretional obstruction of the lower respiratory tract. Bronchiole filled with secretions and purulent exudate; surrounding edema, atelectasis and pneumonia.

respiratory tract. It is less well appreciated that a similar and equally fatal outcome will result from untreated obstruction of the lower respiratory tract. Pathologists are all too familiar with necropsy findings of thick viscid secretions plugging the tracheobronchial tree and of associated atelectasis and bronchopneumonia. (Fig. 1.) It is often assumed that this "terminal pneumonia" is but an associated pathologic finding and is an inevitable result of the patient's primary disease, the surgical treatment or its complications. The fact is, however, that the physiologic effect of the bronchial secretions is in many cases the primary cause or a major contributory cause of death.

Pathologic Physiology of Asphyxia. Obstruction of the lower respiratory tract is due to two major factors: accumulation of secretions in the tracheobronchial tree and failure of the cough mechanism to clear the lungs of the secretions. The obstruction caused by the pooled secretions and at times augmented by aspirated saliva, food or vomitus has both local and systemic effects. Locally, edema and spasm of the bronchioles result with scattered areas of atelectasis. The process can progress to bronchopneumonia, pulmonary edema and formation of lung abscess.

The systemic effects of obstruction of the lower respiratory passages have not been fully appreciated. It has been assumed by many in the past that the major result of the obstruction was anoxemia, and oxygen therapy has been widely advocated. As early as 1926, however, Blalock and his co-workers[1] demonstrated that with partial respiratory obstruction anoxemia was late to appear. Decrease in oxygen saturation of the blood was preceded by marked retention of carbon dioxide and by a resultant fall in the pH of the blood. Anoxemia appeared later and with more marked degrees of obstruction. (Fig. 2.)

The foregoing triad of biochemical changes

(hypercapnia, acidemia and anoxemia) constitutes the syndrome of obstructive asphyxia. Galloway and Seifert,[4] Gray[5] and others have emphasized the significance of the retained carbon dioxide and the resulting respiratory acidosis in asphyxia, and have ascribed many of the lethal effects of asphyxia to these changes. In the early stages of respiratory obstruction the asphyxial blood changes constitute a stimulus to the respiratory center and respirations increase. If obstruction persists, however, the progressive hypercapnia, acidemia and anoxemia all become powerful depressants of the respiratory center with weakening respirations and loss of the cough reflex. As respirations weaken and the expulsive power of the lung fails, secretions accumulate further in the tracheobronchial tree and become more viscid. This in turn increases the asphyxial blood changes establishing a vicious cycle with a lethal outcome.

An understanding of the foregoing changes makes it evident that in obstruction of the respiratory tract oxygen therapy alone has little value. Inhalation of carbon dioxide advocated at times to increase respirations can have an opposite and disastrous effect. Sedation of the patient made restless and apprehensive by carbon dioxide accumulation in the blood can serve only to hasten depression of the respiratory center. It is clear that the essential of successful therapy is to remove the obstructing secretions and re-establish the airway, thus allowing normal absorption of oxygen and elimination of carbon dioxide.

Relief of secretory obstruction in most cases can be accomplished without resorting to surgery. Encouraging the patient to cough, use of postural drainage and the administration of expectorant drugs may be sufficient therapy. Tracheal suction via a catheter introduced through the nostril is of great aid in clearing the airway. Occasionally bronchoscopy with aspiration of the tracheobronchial tree is necessary and effective in removing the secretions.

Value of Tracheostomy. In the treatment of obstruction of the lower respiratory tract, tracheostomy has several advantages. Its obvious value is in providing a facility for aspiration of the tracheobronchial tree. This may be done easily and as often as necessary, even by untrained personnel. Establishment of a tracheostomy also reduces the volume of "dead space" existing between the oronasal passages and the pulmonary alveoli. Carter and Giuseffi[2] demonstrated the volume of the dead space between the mouth and the site of a tracheostomy to be 110 to 125 cc. Reduction of the dead space by this volume would make little difference in a normal patient, but in a weak individual with poor respiratory excursion and a small volume of tidal air it may play a considerable part in recovery. Tracheostomy also removes the resistance to inspired and expired air. Studies on intrapleural pressures before and after tracheostomy have shown the resistance provided by the glottic chink to be significant. Removing this resistance and permitting easier respiration is of value in those with crushing injuries to the thorax as well as in some desperately ill and exhausted patients. The fact that air by-passes the pharynx following tracheostomy is of additional value in other patients who are unconscious or who have paralysis of the pharynx. When the swallowing reflex is absent, saliva tends to pool in the pharynx and is sucked into the tracheobronchial tree on inspiration, increasing the secretory obstruction.

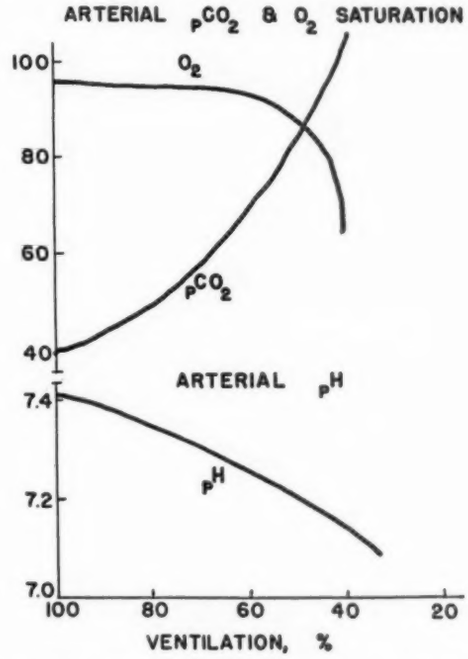

FIG. 2. Blood chemical changes in obstruction of the respiratory tract. Note that decrease in arterial oxygen saturation is preceded by a rise in carbon dioxide content and a fall in pH. These biochemical changes constitute the syndrome of obstructive asphyxia and, if not corrected, have a lethal effect. (Graph adapted from the work of Blalock, A. et al.[1])

Indications for Tracheostomy. Tracheostomy becomes a useful therapeutic tool in patients developing obstruction of the lower respiratory tract who are unable to cough effectively and in whom the usual measures including nasotracheal aspiration or bronchoscopy fail. At times the procedure may even be warranted for the patient in whom it is evident that secretory obstruction will occur even before the disturbance becomes evident.

TABLE II
TRACHEOSTOMY FOR OBSTRUCTION OF LOWER RESPIRATORY TRACT

Neurosurgery	4
Trauma to head	2
Bulbar poliomyelitis	3
Miscellaneous neurologic diseases	5
Fracture of cervical spine	1
Abdominal surgery	4
Thoracic surgery	2

Tracheostomy was performed for obstruction of the lower respiratory tract in twenty-one patients during the two-year period at this hospital. (Table II.) In many of these patients the procedure is thought to have played a significant part in recovery. The procedure was employed in four patients following neurosurgical operations and in two others after severe trauma to the head. Most neurosurgeons are well aware of the danger of secretory obstruction in the unconscious patient as well as the damaging effect of asphyxia on already traumatized brain tissue.

Tracheostomy was performed on three patients with bulbar poliomyelitis, in each of whom there was considerable clinical improvement following the procedure. Galloway and others have emphasized that many of the fatalities from bulbar poliomyelitis are due to the lethal effects of obstruction of the lower respiratory tract and asphyxia rather than the action of the virus itself on the central nervous system. Paralysis of the pharynx in the patient with bulbar poliomyelitis plus the inability to cough provides ideal conditions for the development of tracheobronchial obstruction.

Tracheostomy was also employed in the treatment of five patients with other neurologic diseases: brain tumor, ruptured intracranial aneurysm, multiple sclerosis, progressive muscular atrophy and cerebral hemorrhage with hemiplegia. The procedure was also used with resultant improvement in a patient with quadriplegia due to acute fracture of the cervical spine, in whom pulmonary complications developed.

Tracheostomy has a definite place in the treatment of obstruction of the lower respiratory tract following abdominal surgery. In certain patients who are unable to cough effectively because of pain from abdominal incisions and in whom nasotracheal suction cannot relieve the secretory obstruction, tracheostomy may be life-saving. The procedure was carried out in four patients following abdominal operations in this series, with favorable results. Two illustrative cases are reported:

CASE I. J. L., a debilitated eighty year old man, was admitted on January 28, 1955, in a semi-comatose condition. There was a poorly substantiated history of abdominal pain and vomiting of four days' duration. Examination disclosed an irreducible incisional hernia at the site of an old right rectus wound. There were signs of strangulation of the bowel and of intestinal obstruction. There was also evidence of pulmonary emphysema and both lower lobes of the lungs were full of coarse, moist rales. Following correction of severe electrolyte imbalance, laparotomy was performed. There were two perforations of the ileum at the site of incarceration and there was diffuse peritonitis. The perforations in the bowel were repaired and the hernia was reduced. At the conclusion of the abdominal operation tracheostomy was performed. The patient remained in poor condition following surgery. He was extremely feeble and unable to move about or cough effectively. Frequent tracheal suction through the tracheostomy tube was necessary to remove purulent tracheobronchial secretions. It was thought that management of the pulmonary complication by the tracheostomy contributed materially to the patient's eventual recovery.

CASE II. P. H., a sixty year old man, was admitted to the hospital with advanced carcinoma of the urinary bladder. Preoperative studies revealed evidence of bronchiectasis and pulmonary emphysema as well as a chronic duodenal ulcer. Total cystectomy and bilateral ureterosigmoidostomy were performed on January 28, 1954. The postoperative course was generally satisfactory until the tenth postoperative day when signs of mechanical obstruction

of the small bowel appeared. Laparatomy was performed for obstruction of the ileum by adhesive bands in the left lumbar gutter on February 8th. Following the second operation signs of bronchopneumonia developed and nasotracheal suction was carried out at frequent intervals. On February 11th, the patient was explored for the third time because of signs of an acute surgical condition of the abdomen. A perforated duodenal ulcer was discovered and repaired. Tracheostomy was performed at the conclusion of this procedure. The patient's course was complicated further by wound disruption on February 20th and by massive upper abdominal hemorrhage presumably from the duodenal ulcer from February 22nd to February 28th. He remained in critical condition throughout this period. All those in attendance believed that the tracheostomy was invaluable in controlling the pulmonary complications and in contributing to the patient's final recovery and discharge from the hospital.

Tracheostomy was also performed upon an eighty-four year old man with massive upper abdominal hemorrhage complicated by bronchiectasis and on a fifty-nine year old man with pneumonitis and multiple small bowel fistulas complicating abdominal surgery. Tracheostomies were performed upon two patients who had undergone extensive thoracic surgery in this series. Tracheostomy following chest surgery or crush injuries to the chest not only allows frequent aspiration of the tracheobronchial tree but also relieves pain by allowing easier respirations. Carter and Giuseffi have also demonstrated that paradoxic motion of the chest wall is eliminated because of diminished intrapleural pressures during respiration following tracheostomy.

TECHNIC OF TRACHEOSTOMY

An elective tracheostomy performed upon an anesthetized patient with an endotracheal airway in place is a simple procedure. A few difficulties will arise when an elective tracheostomy is performed using local infiltration anesthesia. An emergency tracheostomy, however, performed for upper respiratory obstruction upon a cyanotic patient struggling for air may be a trying and hazardous procedure. The surgeon's difficulties are increased many times if tracheostomy has been performed previously and the normal planes are obscured in a mass of scar tissue. Unless the situation is one of the utmost urgency it is well to defer surgery until several essential aids are available. These include adequate lighting, suction, a supply of oxygen, a set of instruments for emergency tracheostomy and, above all, a capable assistant.

The patient should be placed in a supine position with his head extended if possible. If partial obstruction exists, however, this will cause complete obstruction and the patient must be allowed to assume a semi-sitting position. The skin in the midline of the neck between the cricoid cartilage and suprasternal notch is anesthetized with 1 per cent procaine. Skin infiltration alone will usually suffice; if the operation is carried out gently, injection of deeper structures need not be done.

A vertical incision about 5 cm. in length, extending downward from the cricoid cartilage, is made in the midline over the trachea. The incision is carried through the skin and subcutaneous tissues, and through the superficial layer of the deep cervical fascia in the midline between the strap muscles. The strap muscles are gently retracted. The isthmus of the thyroid gland is now visible in the upper portion of the wound. It may be elevated for adequate exposure of the trachea. Occasionally a bulky thyroid isthmus must be divided between clamps before the procedure can be continued.

The trachea is exposed by blunt division and retraction of the loose pretracheal fascia. At this point two small hooks (tracheal retractor, sharp-prong, 6½ inches) are extremely useful for the completion of the operation. One hook is used to pierce the wall of the trachea and lift in forward into the wound. In emergency procedures, particularly in patients with short thick necks, this means of lifting and stabilizing the trachea is of great value. At this time if there is no great need for speed, it is helpful to inject 0.5 cc. of 10 per cent cocaine into the lumen of the trachea through a fine hypodermic needle; this procedure will minimize the coughing and straining when the tracheostomy tube is inserted. A vertical incision is made across two tracheal rings as high on the tracheal wall as exposure permits. The second tracheal hook is placed in the incision and used to retract one edge.

A tracheostomy tube with its liner removed and obturator in place is inserted in the trachea. A No. 6 tube is the size most generally

used for adults. Children may require a No. 4, No. 2 or smaller-size tube. Upon removal of the obturator, the trachea is suctioned with a catheter. The wound edges are allowed to fall together about the tube. No closure is necessary with the possible exception of one or two skin sutures above the tube. The tube is held in place with tapes tied snugly about the neck and a gauze dressing split about the tube is applied to the wound. The Martin tracheostomy tube with an external extension on the inner liner is of value if a bulky dressing must be applied to the neck. The extension prevents retraction of the tube and obstruction beneath the dressing.

The tracheostomy tube should not be changed until one week has elapsed and a tract has formed. Before final removal of the tube it is often wise to occlude it with a small cork for twenty-four hours to assure the adequacy of the laryngeal airway. Following removal of the tube, the edges of the sinus tract may be taped together; the tract usually closes in several days.

SUMMARY

Tracheostomies were employed in the care of sixty-five patients during a two-year period. In forty-four cases the procedure was used to prevent or treat obstruction of the upper respiratory tract. In the remaining twenty-one cases tracheostomy was used for obstruction of the lower respiratory tract.

Tracheostomy should no longer be considered an operation to be employed solely for acute obstruction of the upper respiratory passages. The procedure is also indicated as a prophylactic measure for laryngeal obstruction and as a treatment for secretory obstruction of the lower respiratory tract. It should be employed for the latter condition whenever the patient is unable to expel his tracheobronchial secretions and when nasotracheal suction or bronchoscopy gives only temporary relief.

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Prophylaxis of Postoperative Nausea and Vomiting

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NAUSEA and vomiting in the postoperative period are distressing occurrences. Numerous substances have been suggested for their amelioration once they have developed, but very few compounds have been devised for routine prophylactic use. Of necessity, any such compound for routine use would have to be relatively innocuous. It should not produce respiratory depression and should not interfere with the action of atropine. Recently we have tried a compound of meclizine hydrochloride, 25 mg., and pyridoxine hydrochloride, 50 mg., as a routine preoperative medication. The reported value of these drugs, singly and combined, in the prevention and control of nausea and vomiting associated with motion, pregnancy and radiation therapy, indicated[1–4] their possible usefulness in preventing these symptoms postoperatively.

Meclizine hydrochloride (1-p-chlorobenzhydryl 1-4-methyl benzylpiperazine dihydrochloride) is relatively insoluble in water and this probably accounts for its slow onset and its prolonged effect. In addition to its antiemetic action it is said to have a definite antihistaminic action. Vitamin B_6 is stated to play a significant role in the enzyme systems governing the metabolism of fats, carbohydrates and amino acids. There have been numerous reports in the literature of the efficacy of pyridoxine in controlling nausea and vomiting in pregnancy.

We evaluated this combination of drugs by investigating it as a blind procedure. We were supplied two forms of tablets similar in appearance; one group of patients received a placebo and the other group received meclizine hydrochloride and pyridoxine.* The code was retained by the manufacturer and was not available to the investigators. The patients were unselected and were taken from the general surgical, gynecologic, neurosurgical, orthopedic and urologic services of the hospital. The routine preoperative orders were for two tablets at bedtime the night before surgery and two tablets on the morning of surgery. A sedative order was left, to be administered if needed one hour after the bedtime dose of the study compound. In most instances morphine and atropine were the only other routine preoperative medications. Arbitrarily, patients over sixty-five years of age were given only one tablet at bedtime and on the morning of surgery. Two hundred surgical patients were given one type of medication, and subsequently 200 surgical patients were given the other type of medication. Each patient was interviewed by the same technician on the afternoon of the day following surgery. If the patient was nauseated at that time, he was interviewed again the next day and each day thereafter until the symptoms had cleared. If there was no nausea or vomiting or if these symptoms had occurred but had disappeared by the time the patient was first interviewed, he was not seen again in regard to this study. Patients were not routinely told why the drug was given. However, it was noted on at least one occasion that a patient asked a nurse the reason for the medication and she replied, "Something to keep you from vomiting." Therefore, to keep any "placebo effect" from entering into the study, we had the same technician interview another 200 surgical

* Meclizine hydrochloride, 25 mg., and pyridoxine, 50 mg., is marketed as bonadoxin by J. B. Roerig & Co., Chicago, Ill., who supplied the material for this study.

patients who were given nothing but the routine bedtime sedative plus morphine and atropine before operation. These comprised the control group.

The results of the administration of meclizine hydrochloride and pyridoxine prophylactically for the prevention of postoperative nausea and vomiting are given in Table I. Of the patients given this combination 25.5 per cent had nausea and 18.5 per cent vomited. In the placebo group 57.0 per cent had nausea and 41.5 per cent vomited. In the control group 63.5 per cent were nauseated and 33.5 per cent vomited. We believe the amount of relief from these symptoms is significant. Also, it is of interest that a number of patients who were given compound "R" (bonadoxin) questioned what different medication had been given. When they had been operated upon previously, they had vomited for several days postoperatively; but after the present operation they had not even been nauseated. When we transferred to compound "S" (placebo), not one person volunteered that he had not been nauseated; this was also true in the control group.

We are sure that some will question the high incidence of postoperative nausea and vomiting in our control groups. To our knowledge it is higher than has been reported previously,[5–7] except for a recent report by Didier et al.,[8] who record a higher incidence of vomiting (59.5 per cent as against 33.5 per cent in our series) and an almost identical incidence of nausea (61.8 per cent as against 63.5 per cent). We believe

TABLE I
OVER-ALL PICTURE

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Group "R" (bonadoxin)	200	51	25.5	37	18.5
Group "S" (placebo)	200	114	57.0	83	41.5
Control (no drug)	200	127	63.5	67	33.5

TABLE II

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Major General Surgery (Including Major Gynecologic Procedures)					
Group "R" (bonadoxin)	108	32	29	26	24
Group "S" (placebo)	97	59	61	43	44
Control (no drug)	93	63	66	35	37
Minor General Surgery (Including Minor Gynecologic Procedures)					
Group "R" (bonadoxin)	52	9	17	7	13
Group "S" (placebo)	45	28	62	19	42
Control (no drug)	49	31	63	14	28

TABLE III

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Urologic Service					
Group "R" (bonadoxin)	15	5	33	1	6
Group "S" (placebo)	23	7	30	5	21
Control (no drug)	25	13	52	7	28
Neurosurgical Service					
Group "R" (bonadoxin)	6	2	33	2	33
Group "S" (placebo)	14	8	57	7	50
Control (no drug)	13	10	76	7	53
Orthopedic Service					
Group "R" (bonadoxin)	20	2	10	1	5
Group "S" (placebo)	20	9	45	7	35
Control (no drug)	19	9	47	3	15

that we can explain our high incidence of nausea and vomiting on the following basis: Each patient was individually questioned by the same interviewer. If the patient had had any nausea at all, no matter how slight, the result was considered positive. Vomiting was considered positive if only the slightest retching was present. We find it hard to differentiate between degrees of nausea and vomiting; and we believe that if this criterion is used, one will find a high percentage of patients who have some discomfort from these distressing occurrences. Before starting this study the authors (as do many other surgeons and anesthesiologists) took cognizance of nausea and vomiting only when these occurrences annoyed the patient to a severe degree or became electrolyte problems.

Tables II and III are a breakdown of our cases in regard to the services involved and therefore, essentially, is a breakdown of the type of surgery performed. It was impractical to indicate the individual operative procedures employed. Most of our cases fell into the major and minor general surgical groups, which include gynecology. In the major general surgery group there seemed, to us, to be a significant difference between the bonadoxin group and the control and placebo groups. Nausea was reduced about 50 per cent and vomiting was reduced slightly less than this amount. In the minor general surgical group (including minor gynecology) the effect of the compound was even more significant in reducing nausea; the reduction was from 62 and 63 per cent, respectively, in the placebo and control groups to 17 per cent in the bonadoxin group. Also, vomiting in the minor general surgical group was reduced quite significantly by bonadoxin, but we find it difficult to explain the difference between the incidence in vomiting in our control and placebo groups in the minor general surgical group. The number of patients from the urologic, neurosurgical and orthopedic services is small and is probably not significant statistically, but we are including our figures on these patients for the interest of the specialists in these fields. (Table III.)

Of the patients given inhalation anesthesia

TABLE IV
RELATION TO TYPE OF ANESTHESIA*

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Inhalation Anesthesia					
Group "R" (bonadoxin)	62	27	43	25	40
Group "S" (placebo)	86	57	66	46	53
Control (no drug)	66	50	75	32	48
Pentothal					
Group "R" (bonadoxin)	99	19	19	11	11
Group "S" (placebo)	86	45	52	30	34
Control (no drug)	108	63	58	26	24
Pentothal with Curare					
Group "R" (bonadoxin)	22	6	27	0	0
Group "S" (placebo)	19	12	63	7	36
Control (no drug)	19	11	57	6	31

* The number of patients given spinal and local anesthesia were statistically insignificant.

TABLE V

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Duration of Procedure 0 to 60 Minutes					
Group "R" (bonadoxin)	113	20	18	14	12
Group "S" (placebo)	86	45	52	32	37
Control (no drug)	101	58	57	27	27
Duration of Procedure 60 Minutes and Over					
Group "R" (bonadoxin)	86	24	27	22	25
Group "S" (placebo)	114	70	61	51	44
Control (no drug)	98	68	69	37	37

(Table IV), we found that bonadoxin had little value in preventing the high percentage of nausea and vomiting generally associated with this type of anesthesia. There was a marked beneficial effect in the pentothal® and pentothal-curare groups. We strongly recommend use of the compound prophylactically in patients receiving this type of anesthesia.

Although the medication was found to be effective in lessening the incidence of nausea and vomiting in surgical procedures longer than one hour, it was more effective in procedures of less than one hour. (Table V.)

Our usual preoperative medication was morphine and atropine in addition to bonadoxin.

TABLE VI
RESULTS IN CASES IN WHICH PREOPERATIVE MEDICATION WAS MORPHINE AND ATROPINE*

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Group "R" (bonadoxin)	187	48	25	36	19
Group "S" (placebo)	183	110	60	80	43
Control (no drug)	173	102	58	59	33

* We believe that the number of patients in the group treated with demerol and scopolamine, and the group treated with chloral hydrate and atropine is not statistically significant.

TABLE VII
RELATIONSHIP TO SEX

Groups	Total No. Patients	Nausea	Per cent	Vomiting	Per cent
Male					
Group "R" (bonadoxin)	71	10	14	7	9
Group "S" (placebo)	75	28	37	22	29
Control (no drug)	70	36	51	17	24
Female					
Group "R" (bonadoxin)	129	41	31	30	23
Group "S" (placebo)	125	86	68	61	48
Control (no drug)	130	91	70	47	36

TABLE VIII
UNTOWARD REACTIONS

Groups	Reactions
Group "R" (bonadoxin)	Four patients had chills in the recovery room; etiology of these chills was not clear; we do not believe there was any relation to the drug
Group "S" (placebo)	No reactions
Control (no additional medication)	One patient had a chill

When the figures were analyzed from this viewpoint, they closely paralleled the over-all results as we would expect. (Table VI.) The number of patients given demerol® and scopolamine® or chloral hydrate and atropine or some other combination was, in our opinion, a statistically insignificant number and therefore is not listed.

Curiously enough, we found that women were nauseated and vomited more frequently after surgery than men. Percentagewise, the effect of bonadoxin was equal in both sexes in relieving these complaints. (Table VII.)

There were no untoward reactions to bonadoxin. Four patients given the drug had chills in the recovery room. However, we do not believe this was due to the drug since one patient in the control group also had a chill. (Table VIII.)

It is our belief that bonadoxin is a safe and effective method of reducing the incidence of postoperative nausea and vomiting.

SUMMARY

A group of 600 surgical patients were studied in regard to postoperative nausea and vomiting. Two hundred patients were given a combination of meclizine hydrochloride and pyridoxine (bonadoxin); 200 patients were given a placebo; an additional 200 persons received no medication, but all groups were interviewed and meticulous records kept. Each group was

studied in regard to the type of surgical procedure, the type of anesthetic employed, the duration of the procedure, the type of preoperative medication and the relationship of postoperative nausea and vomiting to sex and age. As a result of this study, it is our belief that the routine prophylactic use of the combination of meclizine hydrochloride and pyridoxine is a safe and effective method for lessening the incidence of postoperative nausea and vomiting. We are employing this preparation as a routine preoperative medication.

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The Follow-up Examination for Cancer

WITH A FEW REMARKS ON THE DIAGNOSIS OF CANCER

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TWENTY-FIVE years ago, following a survey which was made for the American Cancer Society, the author recommended that there be a central follow-up of cancer patients in all large cities.[1] On the basis of observation and treatment of cancer in nineteen or twenty moderate sized cities, it was thought that money could best be spent on finding out exactly how the average cancer patient fared after his treatment. This was exclusive of those treated in the large centers where statistics were routinely kept. There was just one central cancer follow-up in Detroit at that time under the aegis of the Board of Health. Aside from this, as far as we know, the idea expressed in the aforementioned paper was not carried out anywhere and never sparked any interest. However, a few years ago the American College of Surgeons stated that approval of cancer clinics in general hospitals in 1955 would require a hospital follow-up registry of cancer patients treated in the institution.

In the course of a follow-up study of 572* personally treated cancer patients, our office follow-up procedure was systematized. This paper represents observations upon methods of examination in routine follow-up, plus a few general observations on the diagnosis of cancer.

FOLLOW-UP PROCEDURE

It is not necessary to keep an elaborate chart form with various minute details on past history and physical data, such as is valuable for statistical purposes. The routine office history suffices. It is very desirable for follow-up purposes to record the name of another relative in addition to the husband or wife. A kardex file giving the patient's name, address, diagnosis and record of follow-up visits is used. The mobile indicator designates the date of the next intended visit, so that a reminder postcard can be sent.

Often, persistence in following up a person, checking where he last lived and so forth is rewarding. In three instances the name of the patient's employer listed on the chart led to successful contact. Five or six patients with uncommon names were searched for through the phonebook, and every such name called in the effort to trace the patient; this method also proved to be successful. Hospital insurance slips often revealed a relative's name. In one case the chart contained an attorney's letter regarding the patient's estate which gave the date of death. A good deal of information can be obtained from the Health Department's Vital Statistics Bureau. Among eighty patients who were difficult to trace, the Health Department had records that thirty-seven or thirty-eight had died. If the follow-up is kept up-to-date and patients are contacted on a six-month or yearly basis, it is much simpler than if allowed to lapse for two or three years. Occasionally one finds an amusing incident illustrating how persistence is rewarded. One patient did not answer her phone, and a house call revealed the reason. She was deaf, but otherwise very much alive. One patient, who we knew had died, could not be traced. The Board of Health had no record of her death. A phone call to a relative revealed that she had died in Florida and that the body had been brought back and buried in Detroit; they knew only the cemetery where she had been buried. A phone call to the cemetery caretaker gave us the date of death and established how long the patient had lived. In another instance, a follow-up postcard was returned with the laconic statement, "I *past* on March 1, 1954."

* Statistical data to be published elsewhere.

THE FOLLOW-UP EXAMINATION

For the first year patients with cancer of the head and neck are contacted every one or two months. Patients with cancer of the breast, stomach or bowel report every three months for the first year. After the first year examination every six months suffices. After five years a yearly contact is made.

Intraoral Cancer. The follow-up examination need not be elaborate. It consists of brief inspection and palpation of the intraoral lesion, plus careful palpation of the neck to determine any nodule which has appeared since the last examination. This is highly important, for it is of considerable value to the patient if a suddenly appearing metastasis is recognized early. Many patients with oral carcinoma are discharged from treatment with the local lesion removed or destroyed, the idea being that if there should be metastatic spread into the neck, it can be recognized early enough to effect a cure by radical neck dissection. By and large, if the first year and a half to two years are free from recurrence, the patient has an excellent chance of staying well.

Cancer of the Stomach. The first year is the critical time. The internist must, *per se*, be concerned with the follow-up of patients with cancer of the stomach because they are more apt to return to him. There is not too much to be discovered that will prove beneficial to the patient because when the disease recurs, the end is usually not far away. The usual course of our patients has been freedom from symptoms for either six, eight or ten months, and then rapid recurrence and death within twelve or fourteen months from the time of the operation. Often the recurrence is silent and is ushered in only by a suddenly recognized anemia. At other times, the first sign of recurrence is a painless jaundice even before the liver becomes enlarged, due to metastatic deposits at the hilum of the liver. The jaundice can come on quite suddenly, even overnight. In other instances there is more or less violent pain in the abdomen starting five or six months postoperatively, due to metastasis to the retroperitoneal nodes and bed of the pancreas. Many of these patients have no evidence of obstruction during the entire course of their disease.

In a few patients reoperation is feasible after resection of the stomach for cancer. Bowden, Booker, and McNeer[3] have recently reported the results of re-exploration in thirty-seven patients who had had previous resections for gastric carcinomas. There was only one five-year cure. This patient had a small, local 3 cm. recurrence at the gastroenterostomy stoma. (The only symptom was occult blood persisting in the stool for three months.) Their conclusions were that re-exploration must be performed on minimal indications to accomplish a great deal; and, more important, there should be more adequate and aggressive primary surgical resection.

Cancer of the Colon. Early signs of recurrence are suddenly appearing constipation perhaps with abdominal cramps or bloating, frequently alternating with diarrhea. There may be a painless enlargement of the liver which is nodular, preceded only by two to three months of anemia and loss of weight.

Cancer of the Rectum. Recurrence is often silent and is ushered in chiefly by anemia, loss of weight and enlargement of the liver. At other times intra-abdominal masses are present which cause multiple small bowel obstructions; then the course is tedious and uncomfortable. A long intestinal tube may relieve the obstruction for a short time. The condition will recur and then the tube must be passed again, unless the patient dies from the initial obstruction in two or three weeks. We have had one patient who lived for three months with a long tube inserted intermittently. Some recent studies have indicated that following any resection of the colon, proctoscopy and barium enema should be done periodically to discover newly formed polyps and also a new carcinoma of the colon in a different situation. We have had both of these experiences.

Cancer of the Breast. The follow-up examination of cancer of the breast, must include specific observation. It consists of a careful examination for local skin recurrences (very careful palpation of the whole operative site including the entire chest wall on that side), plus palpation of the liver, a careful chest examination, and inquiry as to back pain. We have seen several patients in whom back pains continued for six or eight months or even longer before x-rays showed spinal metastasis. This is well known, but one must be careful not to rely on aspirin treatment for a month or more before recognizing the possibility, or more correctly, the probability of recurrence. We are sure this happens often in the general prac-

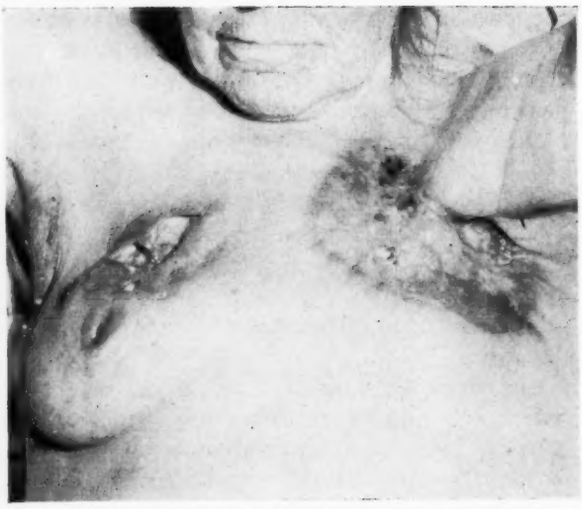

FIG. 1. Case 1. Patient had had no treatment whatever. She was first seen about five and a half years after onset of cancer in left breast. Note practically complete destruction of left breast. Right breast shows indolently advancing ulceration involving half of the breast. Patient died from intrathoracic and mediastinal involvement ten months after photograph was taken.

tice of medicine. Often the pain in the back starts so soon after the operation that one feels morally certain that spinal metastases were present before the operation. We have several instances of this in our files.

Cases of cancer of the breast are so numerous in the average surgical practice that it is not hard to appreciate the variable duration of the disease, both treated and untreated. The experience is sobering, especially when one quotes statistical results involving a large number of cases. It is sometimes difficult to relate these figures to the individual case.

It is well known that patients with cancer of the breast may live more than five years without treatment. One must assume that the body has some defense against cancer which in these particular instances is more potent than usual. The following case illustrates this point.

CASE I. The patient, Mrs. U., had had no treatment whatever. She was seen about five and a half years after the onset of her disease (as nearly as she could remember). The left breast had been entirely destroyed by a slowly growing carcinoma which ended as a very indolent ulcer, about 2 by 4 inches in diameter, on the anterior chest region and flush with the skin. The disease had spread over into the opposite breast which again showed rather indolent slowly advancing ulceration involving half of the right breast. (Fig. 1.) The patient died about ten months later from intrathoracic and mediastinal involvement.

A large proportion of patients with cancer of the breast who came to our follow-up examination after five years had no axillary involvement at operation. However, in cancer of the breast especially, one sees late recurrences, long after the five-year "cure" period, which everyone agrees is merely a convenient approximation for statistical purposes. Generalized metastasis may occur long after the five-year period.

CASE II. The patient, a fifty-nine year old woman, had undergone radical mastectomy in October, 1947. There was high axillary node involvement. She was well until February, 1954 (six and a half years), when she complained of backache, pain in the region of the right hip and down the right anterior thigh. X-ray a short time later showed osteolytic metastasis and compression fracture of the fifth lumbar vertebra.

CASE III. Mrs. M., a sixty-seven year old woman, had undergone left radical mastectomy in May, 1946. In April, 1954 (eight years later), she noticed a reddened mass in the left wall of the chest in the region of the eighth rib. A localized recurrence, about 3 cm. in diameter, involving the skin and subcutaneous tissues but not the chest wall, was excised. One year later (April, 1955) she was well and free from any demonstrable recurrence.

CASE IV. Mrs. E. B. had undergone mastectomy for cancer of the left breast in Germany in 1933. At that time she was forty-one years old. In 1939, a node had been removed from the left lower axilla, and this was followed by a course of twenty-five x-ray treatments. These were repeated two years later.

In 1941 local excision had been performed for cystic disease of the right breast. A small nodule along the scar of the left breast was excised in 1943 and was found to be a low grade carcinoma. She remained well until 1953 when she noted a small nodule to the left of the ancient left mastectomy scar. This grew very slowly, and it was not until two years later (May 19, 1955) that she consulted a doctor. Examination showed a 2 cm. subcutaneous mass about 1 cm. lateral to the mastectomy

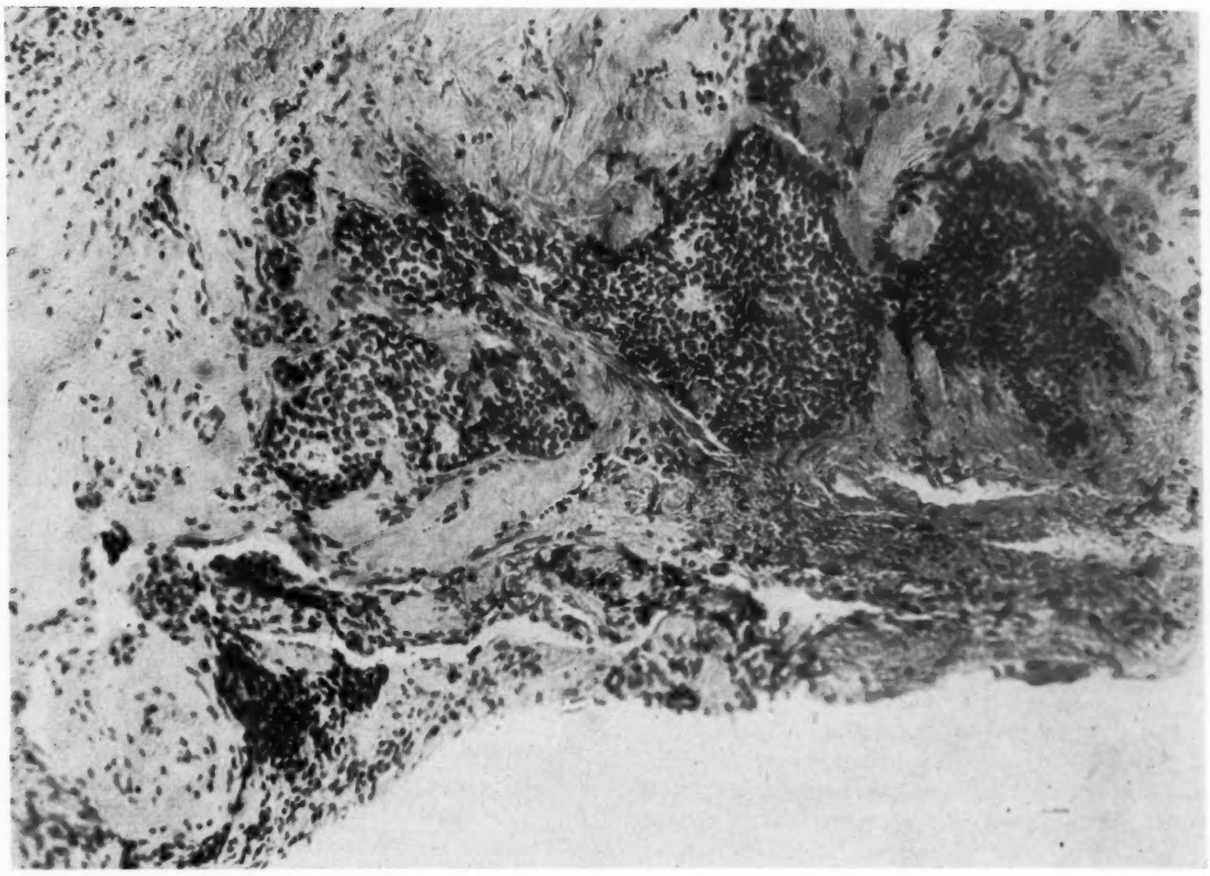

FIG. 2A. Case IV. Partial radical breast amputation was performed in 1933 when patient was forty-one years old. Apparently low grade carcinoma recurred along suture line six, ten and twenty years after operation. Microscopic appearance ten years later.

scar of twenty-two years previously. The excised specimen showed carcinoma. (Fig. 2A and B.)

Cancer of the breast is characterized by its very protean manifestations when it does metastasize. In the observation of advanced cancer of the breast, one sees bone metastasis, chest metastasis, brain metastasis and abdominal carcinomatosis. Pleural effusion may come on insidiously. On more than one occasion we have given a patient aspirin for some generalized pain and at the next visit, perhaps a month or two later, found to our chagrin that a large pleural effusion was present.

The following case illustrates the protracted course and widespread involvement which one sometimes sees.

CASE V. Four years after radical mastectomy, extensive spinal and multiple skin metastases developed in this patient. Severe root pain occurred, with ensuing morphine addiction. She was bedridden for a year and a half, and died from abdominal and chest metastases. (Fig. 3.)

A new chapter is being written in medicine concerning the treatment of advanced cancer of the breast. Considerable judgment and experience are required today for the proper balancing of hormone treatment, x-ray therapy, surgical castration, adrenalectomy, hypophysectomy, pain-relieving medication and neurosurgical relief of pain.

Cancer of the Cervix. The follow-up observation, if irradiation has been used, is, of course, the close and frequent inspection of the cervix (every month or two for the first year). The Papanicolaou cervical smear has been added to this.

Rectal examination may indicate a small hard mass to one side of the cervix, or a slight residual thickening in the parametrium which, if it persists, may be the first and only indica-

FIG. 2B. Case IV. Shows another local recurrence twenty-two years after original mastectomy. This nodule had already been present two years.

tion of residual or recurrent disease. This nodule or parametrial thickening may be present six months before symptoms of recurrence are manifest.

The recurrence is frequently ushered in by pain in the lower spine about the sacral region. It descends along one posterior thigh and becomes increasingly severe. Although extension of the disease in the para-aortic nodes beyond the pelvis and even general visceral metastases can occur, the usual course is constriction of the ureters, hydronephrosis, pyonephrosis and death from uremia. Cancer of the cervix causes death from either uterine artery hemorrhage or strangulation of the ureters. Usually, at the time of autopsy, the disease can be encompassed in a sphere the size of a golf ball, centered at the cervix. It is very difficult to relieve this obstruction by operations upon the ureters or the kidneys because there is almost always (if not invariably) residual disease in the pelvis. After recurrence is recognized, there is a period of six months or a year, probably not longer, during which the clinical course is frequently very painful with severe and increasing back pain, often resisting therapeutic efforts.

Cancer of the Ovary. Many patients with this condition come to the doctor with masses in the abdomen which have been symptomless; often the beginning of ascites is already present. Many times the patient has very little to look forward to in the future. One patient, however, was operated upon originally in 1936, again by us in 1948, and died in 1952. The disease was still relatively local when she died.[4] The cause of death was hemorrhage from a mass low in the left pelvis which ulcerated into the left vaginal floor.

DIAGNOSIS

The problem of early cancer diagnosis is too broad for much imprint to be made on it by either annual examinations for cancer or cancer detection clinics. It involves the general day-to-day practice of almost the entire field of medicine. Between one yearly examination and another, many cases of cancer will go from an early to an advanced stage.

An examination specifically directed toward cancer detection will aid in the discovery of a wide variety of miscellaneous precancerous conditions such as mouth lesions, warts, moles, benign breast tumors, cervical erosions, rectal polyps and skin cancers. The last condition can usually be cured five years after first being discovered. The few cases of cancers of the breast, rectum and cervix that are screened out are discovered at a great expense. It is doubtful if very many cases of intra-abdominal cancer are discovered which were not previously suspected.

Lay propaganda has been so effective that patients are much more informed about cancer than they were ten years ago.

CASE VI. This patient had consulted a doctor because of a small lump in the breast one year previously. It was very insignificant in appearance, and the advice given to her was to leave it alone unless it "bothered her." She sought no other medical opinion and had not thought of doing so. Only after reading about the six danger signals in the spring cancer campaign (e.g., a lump in the breast may be cancer) did she decide to do something about it. Examination revealed a stony hard, 3 cm. mass in the inner quadrant of the breast with skin dimpling over it. The condition had given her no concern until she was educated to its significance.

The lay public is frightened; every operation connotes the possibility of cancer. However, today they will accept the diagnosis better than formerly, will talk and consider the prognosis with more understanding, and some, at

least, will rationally accept the consequences. They know that all tumors should have pathologic diagnoses, and are informed about immediate frozen section examinations.

Unfortunately, there are many patients who cannot be cured by early diagnosis. The propaganda would ring truer if this fact were mentioned.

CASE VII. Mrs. R. L., a thirty-four year old librarian, was very well educated and had observed her husband and four of her co-workers die from cancer. These deaths had made her an interested and cautious student of the disease and all its facets and treatment.

On August 8, 1951, she appeared for examination stating that she had noticed a small painless lump in the outer quadrant of the left breast one week previously. It appeared three days before her menstrual period, and she thought it might be somewhat smaller than when first noted. There was a small 2 cm. nodule in the outer tail of the breast, and already a "definite solid mass high up in the left axilla, somewhat larger than the mass in the breast." Radical left mastectomy was performed nine days later. The axilla was cleared as thoroughly as possible because of the lateral situation of the lesion. Three stony hard nodes, fully 2 cm. in diameter, were found in the axilla.

Microscopic examination revealed "actively growing adenocarcinoma with lymph node metastasis, highly malignant."

She was well for two years and three months. Chest wall metastasis then developed at the inner end of the clavicle and sternum, followed by mediastinal spread. She died one year later from cerebral metastasis.

In spite of informed awareness, and early diagnosis and adequate treatment, the outcome was inevitable.

The diagnostic problem varies for different body regions. In our experience, symptomatically early carcinoma of the stomach can be diagnosed by any careful physician who has the thoroughness to order an x-ray examination if a patient has had vague indigestion for more than a few weeks. The history is elusive, unless indigestion starts suddenly and sharply from previous good health. The roentgenologist makes the diagnosis. We have seen patients in whom x-ray examination failed even in good hands; when it was repeated a short time later

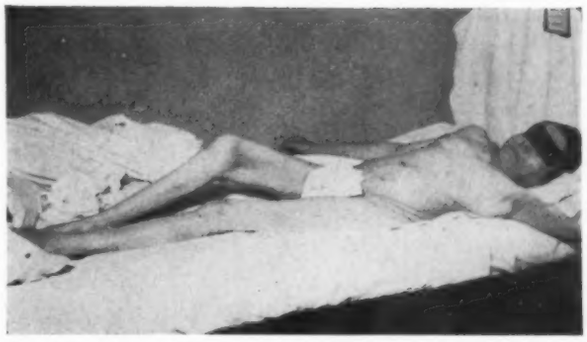

FIG. 3. Case v. Spinal and multiple skin metastases starting four years after mastectomy, slowly spreading throughout the body. Patient lay in bed for one and a half years, occasionally being able to raise her right knee for several days as some of the edema of the spinal cord temporarily subsided, then recurred. There was severe root pain, drug addiction, finally abdominal and chest metastases.

by others, a large carcinoma was evident, usually, but not always, in the upper end of the stomach. The following case illustrates this point.

CASE VIII.* S. S., a sixty-five year old man, began having intermittent upper abdominal pain ten months prior to examination. The pain was located in the paraumbilical and epigastric regions, and usually occurred after a heavy meal. Five months previously he had been thoroughly examined at a well known clinic where routine x-ray and laboratory examinations of the stomach, small bowel and colon gave negative results. He continued to have epigastric pain, unrelieved by and unrelated to meals. Finally, an exploratory operation was advised (six weeks before present admission), the diagnosis being either intermittent small bowel obstruction or a lesion of the pancreas.

He then went to another clinic (one month before present admission). X-rays taken there were reported as negative except for suggestive evidence of abnormality at the cardioesophageal junction. Although esophagoscopy showed a prominence at the cardia with intact mucosa (it resembled a varix) and repeat x-ray showed a constant smooth indentation at the cardia, it was thought that the data were not positive enough to warrant laparotomy at that time. A bland diet and powders were prescribed and the patient was urged to return in three weeks. During the previous two months the pain had

* From SALTZSTEIN, H. C. Carcinoma of the gastric cardia. *Harper Hospital Bulletin* (Detroit), 9: 26, 1951.

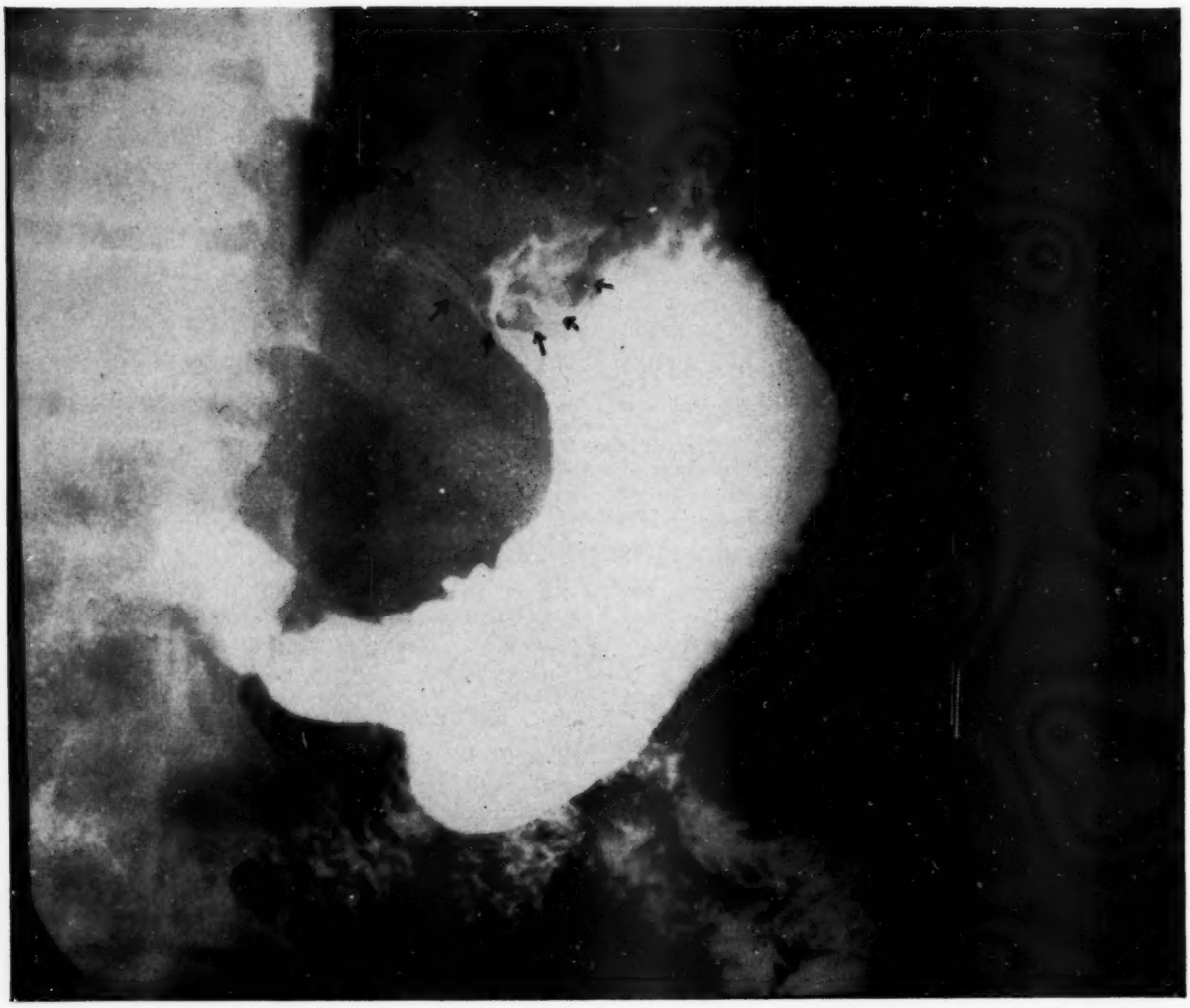

FIG. 4. Case VIII. Carcinoma of cardiac end of stomach. Patient had mild symptoms of indigestion. Two previous x-ray examinations were negative.

increased in severity and was associated with anorexia, nausea and occasional vomiting. During the previous three weeks dysphagia and some back pain had been present, and the patient lost thirty pounds. X-ray at Harper Hospital showed "a slight defect displacing the barium in the fundus of the cardia. It was somewhat flattened and 4 cm. in diameter. It did not interfere with the passage of fluid from the esophagus into the stomach. This mass should be treated as carcinoma." At operation an extensive carcinoma of the cardiac end of the stomach was found. It was resected, but the patient lived only a few months. (Fig. 4.)

Likewise, in the colon, a negative x-ray report should not lull the clinician into a false sense of security in an elderly person if any symptoms of constipation, diarrhea or the like persist.

CASE IX. Mrs. G., a seventy-eight year old woman, had been admitted to the hospital six months previously complaining of abdominal cramps and constipation. Gastrointestinal x-rays were negative at that time and she was discharged. She was fairly well for three to four months, following which cramps and constipation returned. She was readmitted after two weeks of uncomfortable intermittent obstruction. X-ray of the colon at this time was not entirely satisfactory. "The cecum did not entirely fill with a barium enema. However a point of obstruction could not be demonstrated." Laparotomy showed a plum-sized annular constricting growth in the ascending colon just proximal to the hepatic flexure. There were adhesions binding the hepatic flexure to the right abdominal wall and to the undersurface of the liver. When these were

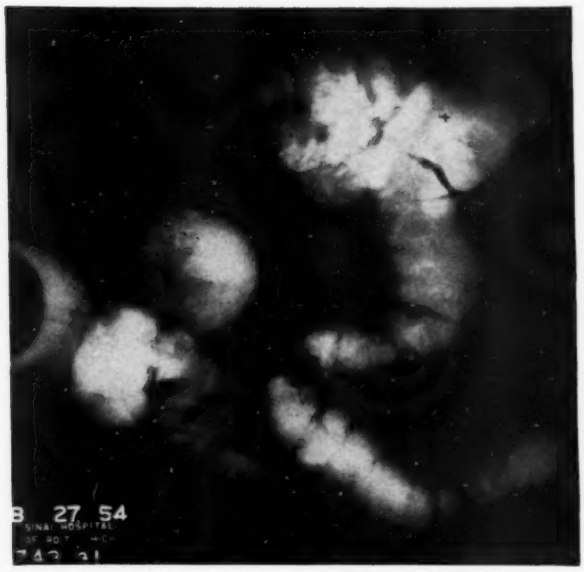

FIG. 5A. Case IX. Seventy-eight year old woman. X-ray examination six months before, when patient complained of cramps and constipation, was negative. Present examination showed a constriction just proximal to the hepatic flexure, but obscured by overlying large bowel.

FIG. 5B. Case IX. Patient had to be rotated into a lateral position to show the annular defect.

separated, a plum-sized annular constricting neoplasm was found just proximal to the hepatic flexure. (Fig. 5A and B.) The fixation of the transverse colon and hepatic flexure to the liver and right lumbar gutter obscured the lesion. Reviewing the x-ray examinations, it was seen that this portion of the bowel overlaid the growth; hence, the diagnostic confusion.

It is beginning to be appreciated that a thorough physical examination of the rectum includes proctoscopy. When dealing with polyps, the rectum is one of the few body sites where cancer detection examinations can be of value.

Any physician interested clinically in cancer sees a large number of miscellaneous breast conditions. Differentiating between the benign tumor of the breast and carcinoma often requires quite expert judgment, but does not take a great deal of time. One either knows or does not know. Gynecologists see many women with lesions of the breast, most of them benign. Whether they want to trust their own judgment and be prepared to perform the radical procedure is a matter of their individual training, day-to-day surgical experience and conscience.

If there is anything wrong with a person's mouth, he usually consults his dentist. Therefore, patients with cancer of the head and neck first go to the dentist, then usually are referred to the oral surgeons.

There is frequently room for disagreement about the pathologist's interpretation of microscopic pathologic material. The more familiar the surgeon is with these microscopic pictures, the safer the future course is for the patient, for it is the surgeon who knows the entire clinical course of the disease.

Thus, the examinations must be countless, the specific conditions must be looked for repeatedly as our clientele ages, and specialism, even in the detection of cancer, is tending along anatomic body regions.

SUMMARY

1. A follow-up routine for patients with cancer adaptable for a private office is detailed.

2. Specific points in the follow-up examination of patients with cancer in the mouth, stomach, bowel, breast or cervix are briefly mentioned.

3. The early diagnosis of cancer in these different body regions is commented upon.

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Inguinal Hernia of the Pelvic Viscera in Female Infants

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INGUINAL hernia of the pelvic viscera in females has been recognized and discussed from very early times. According to Watson,[13] the first authentic record of hernia of the ovary is that of Soranus in the second century A.D. Soranus was the greatest gynecologist and obstetrician of antiquity, and his "Gynecology" was the standard treatise on the subject for fifteen centuries.[4] In compiling statistics of inguinal hernia of the pelvic viscera in females of all ages, Watson[13] collected 469 case reports in which the hernial contents were listed as ovary and fallopian tube, ovary, uterus with or without the adnexa, and fallopian tube, in that order of frequency. These hernias were recorded in 204 children under two years of age. In studying articles on inguinal hernia in the pediatric surgical literature[1–3,5,7,10,11] one finds only a brief mention of the condition in females. The authors of papers dealing with groups of cases of hernia of the female internal genital organs[6,9,12] have not discussed the details of pathogenesis and surgical management. Experiences with twenty-nine cases of inguinal hernia of the pelvic viscera in twenty-eight female infants (one bilateral) is the basis of this report; twenty-five of these infants have been operated upon by one of us (E. E. A.).

FIG. 1. Photograph of the resected ovary and fallopian tube.

PATHOLOGIC FEATURES

The ages of the patients were as follows: five weeks to three months of age, seven patients; three to six months, eight patients; six months to one year, ten patients; one year to two years, three patients. The ages at onset of clinical manifestations were as follows: one week to three months, eighteen patients; three to six months, four patients; six months to one year, four patients; one year to two years, two patients. Thus the condition was first noted in twenty-two or 78.5 per cent of the infants in the first six months of life.

Hernia of the right side was found in sixteen cases, and of the left side in thirteen. In one case the hernia was bilateral.

The pelvic viscera comprising the hernial contents were as follows: ovary and fallopian tube, fourteen; ovary, fallopian tube and uterus, nine; fallopian tube, three; fallopian tube and uterus, two; uterus, one.

A knowledge of the development of the urogenital system[8] is important for the understanding of the pathogenesis of inguinal hernias of the pelvic viscera in female infants. These organs arise retroperitoneally; and as they increase in size, they sag further into the body cavity. In so doing they pull with them the broad ligament which, as it is stretched out, allows the ovaries, fallopian tubes and uterus to move caudally, laterally and somewhat ventrally. During intrauterine life the internal

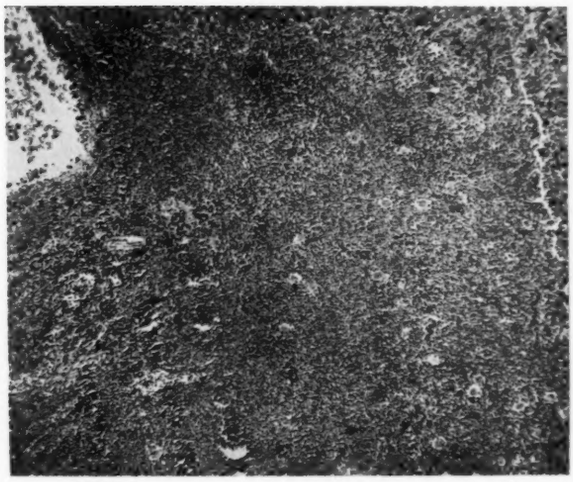

FIG. 2. Microscopic section of ovary showing infiltration of blood cells; a few graafian follicles are seen. Original magnification, × 60.

FIG. 3. Microscopic section of fallopian tube showing hemorrhage in muscular layers. Original magnification, × 60.

genital organs are above the pelvic cavity and are located in the iliac fossa about the twentieth week. At birth these structures are in proximity to the internal inguinal ring, as close as 14 mm. These organs usually do not descend into their permanent position in the pelvis until about the tenth year. The canal of Nuck is normally obliterated about the eighth month of fetal life, but it may remain open for some time after birth or even throughout life.

We believe that the broad ligament plays an important role in the pathogenesis of many of these hernias and leads to the formation of a sliding hernia. This peritoneal fold is in the neighborhood of the internal inguinal ring and is pulled into the direction of the inguinal canal. This, in turn, brings along the internal genital organs, resulting in a sliding hernia. The broad ligaments are attached to the side margins of the uterus, the fallopian tubes are found in the upper borders and the ovaries project from the posterior layers. It is important to remember that the blood supply of the ovary and fallopian tube runs in the layers of the broad ligament.

All authors agree that hernia of the ovary and fallopian tube is the most frequent variety; the incidence in our cases, 48 per cent, is the same as that recorded by Watson.[13] These structures may be in the inguinal canal or outside the external inguinal ring. In our experience they were the sole contents of the sac, although they may be accompanied with intestine. The most common complications are torsion and strangulation of the ovary and fallopian tube. If intestine enters the sac, incarceration may occur as in other varieties of inguinal hernia. We have noted instances in which incarcerated intestine was reduced prior to operation, leaving the ovary still in place in the sac. Episodes of irreducibility were noted in the histories of twelve of our patients. Three infants were operated upon during an episode of incarceration; in two of these the circulatory damage was not marked, and in the remaining patient hemorrhagic infarction necessitated salpingo-oophorectomy. A report of the case of strangulated hernia follows.

CASE REPORT

B. C., a female infant six weeks of age, was admitted to the Beth-El Hospital on August 29, 1951. The child had been well until one week before admission; since that time she had been irritable and cried frequently. Her mother noted a firm, tender mass in the left inguinal region approximately six hours before the child was admitted to the hospital.

During physical examination the child cried constantly. Her temperature was 99.4°F., the pulse rate 98 and the respiratory rate 22. There were no abnormalities of the head, heart, lungs, abdomen or extremities. A firm, tender, nodular, irreducible mass occupied the left inguinal region. Urinalysis was normal. The hemoglobin content was 11.6 gm. per cent; the leukocyte count was 15,000, with polymorpho-

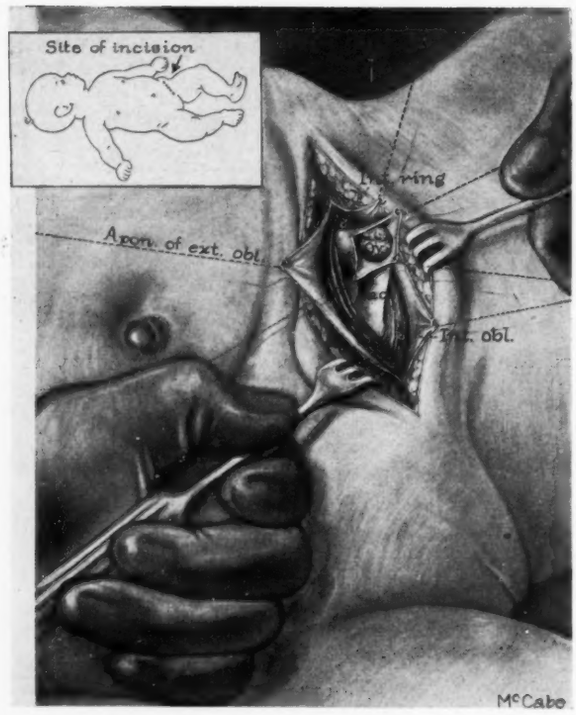

FIG. 4. Drawing illustrating site of incision (inset); the hernial sac has been opened and the ovary is seen.

nuclear leukocytes 50 per cent, lymphocytes 48 per cent and eosinophils 2 per cent.

Operation was performed on August 29th by one of us (J.M.L.). With the patient under ether anesthesia a left inguinal incision was made through the skin and superficial fascia. The aponeurosis of the external oblique muscle was divided in the line of its fibers. The inguinal canal was filled with a tense hernial sac, bluish in color. The sac was opened on its anterior wall and found to be completely occupied by a dark blue ovary and fallopian tube; both of these structures were enlarged and the fallopian tube was distended. Further examination revealed a torsion of the ovary and fallopian tube of 360 degrees. There was no change in the appearance of these organs after the twist was relieved and the organs were washed with isotonic solution of sodium chloride. The blood vessels at the attachment to the broad ligament were divided and ligated, and the ovary and fallopian tube were removed. The neck of the hernial sac was closed with interrupted No. 0000 silk sutures and the sac was excised. The aponeurosis of the external oblique and the internal oblique muscle were united to the inguinal ligament with sutures of the same material. The subcutaneous tissues and skin were closed.

The pathologic specimen (Fig. 1) consisted of an ovary and fallopian tube, dark and hemorrhagic in color. The fallopian tube measured 3 cm. in length and 1 cm. in width, and the ovary was 7 by 13 mm. On microscopic exami-

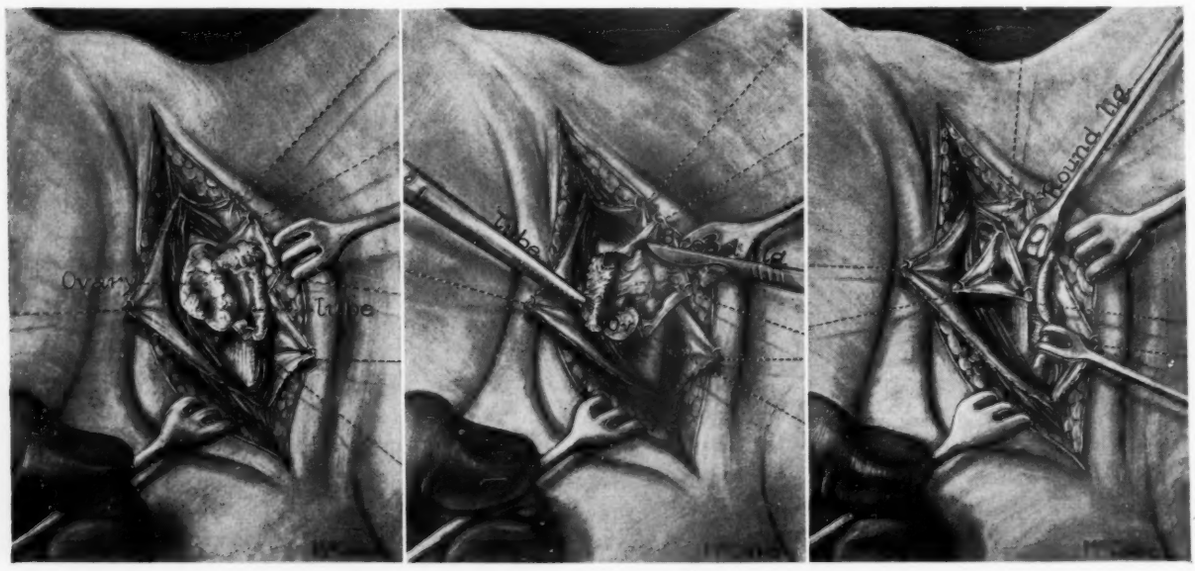

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FIG. 5. Drawing illustrating the relations of the ovary and fallopian tube to the hernial sac.

FIG. 6. Drawing indicating beginning of dissection of the broad ligament from the hernial sac.

FIG. 7. Drawing showing replacement of the ovary and fallopian tube into the peritoneal cavity.

nation (Figs. 2 and 3) a picture of hemorrhagic infarction was seen.

The postoperative course was uneventful. The wound healed by primary union and the infant was discharged from the hospital on the third postoperative day.

The combination of ovary, fallopian tube and uterus in the hernial sac has been the next most frequent variety in our experience, 31 per cent; this is a higher incidence than reported by Watson,[13] 6 per cent. A portion of the fundus was involved and no abnormalities of the uterus were noted. Hernia of the fallopian tube alone (10 per cent) and fallopian tube and uterus (7 per cent) were infrequent. Inguinal hernia of the uterus alone is rare in infants; we have had one such case, in an infant two months of age. The broad ligament was an integral portion of the medial wall of the hernial sac, with the uterus presenting in this location. The "pulling" mechanism of a sliding hernia was evident. This patient is now fourteen years old and has normal menstrual periods.

CLINICAL FEATURES

In the usual case the ovary appears as a hard, rounded swelling which is freely movable and is not tender, often resembling an enlarged lymph node. It may be in the inguinal canal, at the external inguinal ring or in the labium majus. Symptoms arise when torsion and strangulation of the ovary and/or fallopian tube occur. This is manifested by crying and restlessness, and occasional vomiting and fever. The mass in the inguinal region is larger and tender. If the organs are in the labium majus, redness and edema of this structure may be noted.

TREATMENT

The possibility of torsion of the ovary and/or fallopian tube makes repair of inguinal hernia of the pelvic viscera a necessity. Another consideration is the possibility of damage to these structures by injury to the inguinal region.

The infant is usually admitted to the hospital in the morning, is operated upon a few hours later and discharged on the following day. The operative procedure is different from that employed in inguinal hernia in the male:

A transverse incision is made in the skin fold in the inguinal region through the skin and superficial fascia. (Fig. 4.) The aponeurosis of the external oblique muscle is divided in the line of its fibers, leaving the external inguinal ring intact. The hernial sac containing the genital organs is readily identified. The sac is opened on its anterior wall, exposing its contents. (Fig. 4.) Traction on the organs in the sac allows complete inspection, with particular reference to the lines of attachment of the broad ligament to the sac. (Fig. 5.) In some cases the broad ligament is sufficiently lax to allow simple replacement of the organs into the peritoneal cavity, but in other cases the broad ligament must be separated from the adjacent sac, particular attention being given to the blood supply of the viscera. (Fig. 6.) This separation may be very difficult if the uterus is in the hernial sac. In such cases the broad ligament may be left attached to the uterus. After the organs are replaced into the peritoneal cavity (Fig. 7), the sac is twisted

FIG. 8. Photograph of infant taken one day after repair of a left inguinal hernia of the ovary and fallopian tube.

and its neck obliterated. The sac is then transfixed high with a silk suture and tied snugly. In cases in which the organs are replaced into the peritoneal cavity with difficulty, or if the uterus is involved, it is best to close the neck of the sac with a purse-string or running suture, passing the suture through the attachment of the broad ligament. The excess of the sac is excised. The aponeurosis of the external oblique and the internal oblique muscle are united to the inguinal ligament. The superficial fascia and the subcutaneous tissues are closed with fine silk sutures. An aerosol spray is applied to the wound. Figure 8 is a photograph of one of the patients on the day of discharge, showing the healed line of incision.

In our cases there were no postoperative deaths, complications or recurrences.

SUMMARY

The pathologic and clinical features and treatment of inguinal hernia of the pelvic viscera in female infants, based upon a study of twenty-nine cases, are reviewed. A case of strangulation of the ovary and fallopian tube due to torsion is presented. The details of operative technic are described.

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Spinal Headache and Postconcussion Headache

PRELIMINARY REPORT

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THE purpose of this paper is to report an agent which appears to be of value in the treatment of headaches which follow neurosurgical studies. These headaches resulted from spinal punctures, myelograms, pneumoencephalograms and ventriculograms. Also included in this preliminary report is a group of postconcussion headaches.

Rationale of treatment is based upon observations previously published,[1] that in many instances of headache the mechanism appears to be one of vasoconstriction and that relief of pain was obtained by those hydrogenated alkaloids of ergot which have a vasodilating action, with no relief through the use of vasoconstrictors.

Cases accumulated in the past year and a half include headache due to tension, postconcussion headache, so-called "muscle tension headache," headache associated with herniated cervical disc and the headache which commonly is associated with neurosurgical investigative procedures. This report deals with but two of the groups, although in the entire headache series response to a vasodilator was surprisingly efficacious in a significant number of patients, suggesting that vasoconstriction in association with these headaches may be more common than realized.

Relief was obtained in approximately 50 per cent of patients with intense headache by a single sublingual dose of 1.5 to 3 mg. of dihydroergotcristine,* or by a mixture of dihydroergotcristine, dihydroergotcornine and dihydroergotkryptine.* Tablets which differed in size and taste were obtained from two sources. In many instances the relief was dramatic. There were no untoward reactions with repeated doses. Other vasodilators were not as effective. In a number of instances vasoconstrictors such as neo-synephrine® and cafergot® had no effect upon the pain.

Selection of patients yielded a high percentage of successful results. In almost all patients who obtained relief, the headache was associated with tenderness of the extracranial arteries. In many of the failures, vascular tenderness could not be elicited.

METHOD OF ELICITING TENDERNESS

Palpation alone does not reveal the relative degree of tenderness. In our experience, tenderness is best elicited in the following manner: (1) superficial temporal artery: sharp percussion with middle finger. (2) occipital artery: deep pressure and rubbing; usually acutely tender and frequently produces radiating pain to temple or orbit, or both. This tender area is located midway between tip of mastoid and cervical midspinous line. (3) common carotid artery: palpate arterial pulsations and poke rapidly; use a control area, vessels of opposite side if headache is unilateral, other areas if bilateral.

EVALUATION OF RESULTS

Following sublingual administration of the ergot-derived vasodilator, relief of headache in favorable cases began in ten to twenty min-

* Malcadyne, Organon Inc., Orange, New Jersey.

* Hydergine, Sandoz Pharmaceuticals, Hanover, New Jersey.

utes, with the maximum effect usually taking place in thirty minutes.

Patients who obtained complete or marked relief were classified as good results; those who obtained mild, equivocal or no relief were classified as failures. (Table 1.)

TABLE 1
RESULTS

Cause of Headache	Relief	Failure
Spinal puncture	5	2
Myelogram	17	9
Pneumoencephalogram	7	13
Ventriculogram	3	1
Pneumoencephalogram and ventriculogram	1	4
Postconcussion	8	3

Determination of therapeutic results was based upon the effect of a single dose within a half-hour period. In only four cases was the dose repeated at the end of the half-hour period to see if it would augment the effect, the headache disappearing completely with the additional dose. This suggests the possibility that it may be necessary to increase the initial dose.

In no instance was the patient put on a repeated dose schedule to evaluate these alkaloids. If the patients did not obtain satisfactory relief at once, they were classified as failures.

In those patients who obtained good results, medication was repeated only if the headache recurred; this was an infrequent occurrence.

PLACEBO REACTIONS

In addition to the fact that many patients had taken aspirin, empirin,® codeine and even demerol® without satisfactory relief, all were placebo-tested. Eight placebo reactors were rejected. Thirty minutes were allowed for the placebo effect to take place.

Placebo reactors must be interpreted with caution. Patients with carcinoma and other serious organic disease may obtain rapid temporary relief with a placebo. Usually this takes place within five minutes but the relief is of short duration. Nevertheless, in our particular series in order to obtain a strict evaluation of the drugs employed, placebo reactors, whether they obtained long periods or short periods of relief, were discarded as unsuitable subjects.

POSTCONCUSSION HEADACHE

Eleven cases were included in the postconcussion headache group. Eight patients in this group obtained excellent relief of pain with the dihydrogenated alkaloids of ergot. Five of these were medicolegal cases which had not been settled. All eight obtained rapid and satisfactory relief of pain. Headaches lasting weeks and even months disappeared. Two patients who did not respond had abnormal electroencephalograms. One patient who had an abnormal electroencephalogram obtained complete relief. It is too early in this group to speculate how much relationship there is between the abnormal electroencephalograms and the ability to obtain relief. The striking and rapid relief in these patients with a vasodilating agent again suggests the likelihood of a vasoconstrictive mechanism.

The present report consists of eighty-one cases of headache caused by the following factors: spinal puncture, seven cases; myelogram, twenty-nine cases; pneumoencephalogram, twenty-one cases; ventriculogram, five cases; combined pneumoencephalogram and ventriculogram, five cases; postconcussion headache, fourteen cases; and placebo reactors not treated, eight cases.

The effect of the vasodilating alkaloids of ergot upon these headaches, especially those of long duration, can better be appreciated by a few representative case reports.

CASE REPORTS

Postmyelogram Headache

M. W., a thirty-six year old white man, had severe, continuous, generalized headache, regardless of position, for more than two weeks following a cervical myelogram for herniated disk. Superficial temporal, carotid and occipital arteries were extremely tender. Placebo testing, aspirin, empirin and codeine had very little effect upon the headache. Dihydrogenated ergot alkaloids, 1.5 mg., were administered sublingually after placebos had failed to provide relief. In fifteen or twenty minutes the headache began to subside. Pain gradually faded from the occiput, ears, temples, orbits and frontal regions. Complete relief took place in twenty-five minutes. The headache did not recur. The cervical spasm and cervicobrachial pain remained unchanged. This subsided com-

pletely within ten days with motorized intermittent traction.

Postconcussion Headache

M. R., a twenty-six year old white woman, struck the front of her head against the windshield in an automobile accident on February 18, 1956. She was dazed but not unconscious and was taken to St. Agnes Hospital. X-rays were reported as negative. Persistent headache caused the patient to remain in the hospital for one week. Medication given for the headache afforded no relief. Lumbar puncture was performed, but still the headache persisted. After discharge the patient continued to complain of severe, generalized headache and was referred by her physician to the accident ward of the Graduate Hospital on February 28th, three days after discharge. The patient presented a picture of marked discomfort. Examination revealed tenderness of the left occiput. She was admitted for study, and placed in bed, immobile, in order to keep the headache at a minimum. Three placebo tablets sublingually produced no relief. Dihydroergotcristine, 3 mg. sublingually, began to produce relief in five minutes, with complete relief in twenty minutes. The patient could sit up and move about without pain. She stated that the headache had disappeared for the first time since the accident. Complete relief was experienced for thirteen hours, following which there was a very mild return of the headache. The dose was repeated, with complete disappearance of pain.

D. E., a thirty-one year old policeman, sustained a cerebral concussion in an automobile accident. He was unconscious for about two hours. He was discharged from a hospital the same day, but because of persistent postconcussion symptoms without headache he was rehospitalized and discharged five days later. Shortly after discharge severe occipital, frontal and orbital pain, and a sensation of unsteadiness developed, but no vertigo. The patient was referred to the Graduate Hospital. The headache then was of two weeks' duration. On examination, the occiput and supraorbital areas were tender; the superficial temporal and carotid arteries were not. Placebos had no effect. Dihydroergotcristine, 3 mg., produced complete relief in twenty minutes. The headache did not recur.

Ventriculogram

M. R., a fifty-one year old white woman, was admitted to Graduate Hospital because of headaches and abnormal findings on electroencephalogram, which showed a right-sided focus. A ventriculogram did not reveal any abnormalities. Following this procedure severe generalized headache developed with pain radiating down into the right arm and right side of the chest. The carotid artery and right occiput were tender. Acetylsalicylic acid and codeine provided no relief. Approximately six hours after the test, dihydrogenated ergot alkaloids, 1.5 mg. administered sublingually, produced marked but not complete relief within thirty minutes. A repeat dose brought about complete relief. In the evening the headache returned and was again relieved by 1.5 mg. dihydrogenated ergot alkaloids. The following day, a less severe headache developed in the afternoon after the patient had been up for approximately 2 hours. This headache again was not relieved by acetylsalicylic acid and codeine, and the patient herself asked for "the medicine that I take under my tongue." Dihydrogenated ergot alkaloids sublingually produced complete and lasting relief.

Lumbar Puncture Headache

S. V., a sixty year old white woman, was admitted to Graduate Hospital with a diagnosis of a possible brain tumor. This patient had had a lumbar puncture one day prior to admission, and on entry complained of a severe occipitofrontal headache which had not been present before the spinal puncture. Examination at this time revealed evidences of occipital tenderness. Acetylsalicylic acid and codeine had not given the patient any relief, nor did placebos. Dihydrogenated ergot alkaloids, 1.5 mg. sublingually, produced marked relief in thirty minutes, with complete relief in sixty minutes. Headache did not return.

Pneumoencephalogram Headache

J. M., a sixty-eight year old white woman, had had a pneumoencephalogram which failed to reveal any abnormalities. Following this procedure a severe generalized headache developed. This was not relieved by acetylsalicylic acid and codeine. Eight hours after the pneumoencephalogram, examination revealed bilateral carotid artery tenderness. After

placebos had failed to produce relief, dihydrogenated ergot alkaloids, 1.5 mg. sublingually, were administered which produced good relief within twenty minutes, enabling the patient to sleep. She awoke with a moderately severe headache which again responded to dehydrogenated ergot alkaloids, 1.5 mg. sublingually. The headache did not recur.

SUMMARY

Dihydroergotcristine, or a mixture of dihydroergotcristine, dihydroergotcornine and dihydroergotkryptine, are reported as agents for the relief of pain in spinal headache and postconcussion headache.

In a preliminary report of seventy-three patients who did not respond to analgesics or placebos, approximately 50 per cent obtained rapid relief of headache.

The rapid relief in these cases suggests that vasoconstriction is associated with the pain mechanism in a significant proportion of cases. Additional action of these drugs has been reported, such as antistress properties and central sedative effect. What role these additional factors play in the relief of pain is undetermined at this time.

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The Surgical Treatment of Multiple Duodenal Diverticula

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THE indications for surgical treatment of single duodenal diverticula have now been clearly defined and accepted and several technics described.[3,6,7,11,12,16,18,22] Direct attack on the diverticulum rather than sidetracking or diversion procedures now appears to be preferred by the majority of surgeons. However, when symptoms attributable to multiple diverticula occur, and are of such severity that surgical interference appears justifiable, the procedure of choice has not yet become established. Prior to the advent of antibiotics and other supportive adjuncts, the mortality and morbidity associated with surgery in these cases led many to favor conservatism. The hazards and fatal complications were repeatedly emphasized in surgical reports.[3,7] Occasional experiences in which suspected diverticula were resected, only to have the symptoms persist, lent further support to this attitude.[13]

Single diverticula probably occur in about 1 to 1.5 per cent of the population, although Ackerman's investigation on cadavers indicates a higher incidence.[2] Multiple diverticula are not uncommon. Mahorner, in his series of eight operated cases, had four in which more than one diverticula was present and successfully removed.[13] Adams and Budd found five patients with multiple diverticula in their series of sixty-five cases but these were all treated conservatively.[1] Cattell and Mudge mentioned four cases of multiple diverticula in their operated series of twenty-five.[3] Finney found more than one sac in six of his nineteen cases.[7] In 1940, Morton reported a collection of four cases of multiple diverticula without inflammation in the literature from 1920 to 1939; these had been operated upon without a single mortality.[17] In three of these patients resection was carried out; inversion was performed in the fourth. However, he also found nine cases with inflammation. In the latter series there were two deaths.

Only a small number of duodenal diverticula, probably 5 per cent, give rise to troublesome symptoms, most prominent of which are epigastric pain and distress, nausea, vomiting, eructations of gas and occasional diarrhea. Some patients, such as our second case, have in addition chills and fever. Melena may be an outstanding symptom, as in a case of Dr. H. Lindner. This was due to a polyp in a large diverticulum of the third part of the duodenum. (Fig. 1.) In the two cases reported by Dunstan, bleeding occurred from a leiomyoma in a diverticulum of one patient, and from an ulcer in the other.[5] Malignancy is superimposed in rare instances.[20] Jaundice from biliary obstruction is found occasionally. On examination, tenderness in the epigastrium and right upper quadrant is found when acute inflammation is present, but muscle spasm is usually absent. One should attribute symptoms to diverticula only after all other causes for such have been excluded, such as gallbladder disease, common duct stone, peptic ulcer, chronic pancreatitis or lesions of the colon. The upper gastrointestinal x-ray study is the most important diagnostic procedure. When a large diverticulum is found whose sac has a narrowed neck, retaining barium six hours or more and tender on palpation, and when other x-ray studies of the gallbladder and the entire gastrointestinal tract reveal no other pathologic disorders, then only is one justified in blaming the diverticulum as the cause of the patient's illness. Prolonged and intensive medical treatment should be tried before resorting to surgery. When surgery is undertaken, exploration for other pathologic disorders should be thorough.

Procedures employed for both single and

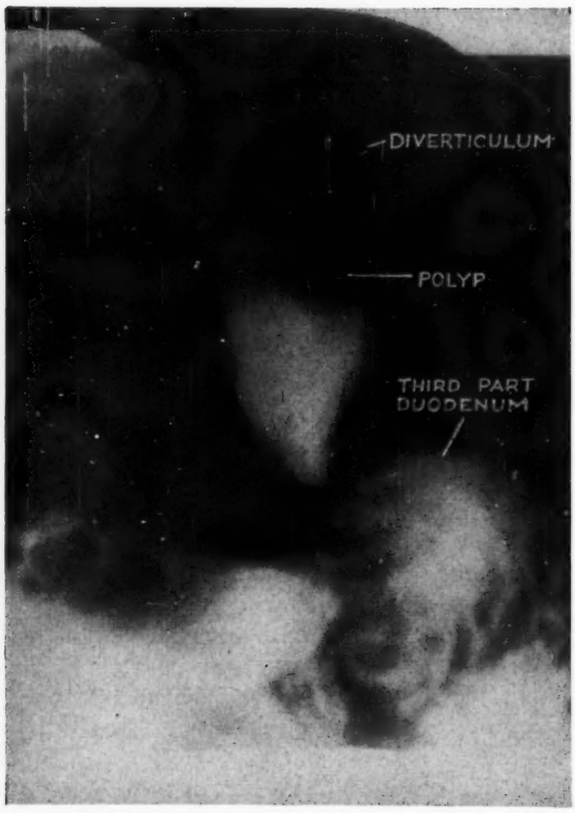

FIG. 1. Polyp in a diverticulum protruding superiorly from the distal third part of the duodenum; patient had severe upper gastrointestinal tract bleeding.

multiple diverticula have either been sidetracking or diversion methods, or direct attacks on the diverticula by several technics. Various methods have been resorted to in the attempt to divert the alimentary stream. Notable among these were gastroenterostomy with and without pyloric occlusion, occlusion of the pylorus with fascia along with gastroenterostomy and vagotomy, and partial gastrectomy. The results from these procedures were good in some, but disappointing in most cases. Cattell employed a sidetracking operation without disturbing the diverticulum in one patient in his series of twenty-five operated cases in whom an inflamed diverticulum was located close to the common duct behind a thin, dilated duodenum. He performed partial gastrectomy and gastrojejunostomy.[3] The end result of this case is not known as it was lost to follow-up. However, he states he has not repeated this procedure and prefers to attack the diverticula directly.[4] Bartlett reported satisfactory results in three cases in which he occluded the pylorus with fascia lata, and performed vagotomy and gastroenterostomy.[22] However, Guthrie and Brown, as well as McQuay, were obliged to disconnect gastroenterostomies and dissect the diverticula to effect a cure when gastroenterostomy alone failed to relieve symptoms.[10,15] Our Case I, in which partial gastrectomy alone was performed, was a failure. However, the diversion of the alimentary stream in addition to excision of the diverticula in our Cases II and III might have been a factor in obtaining satisfactory end results.

Four methods of direct attack have been employed: (1) excision and suture, as described by Pearce;[18] (2) inversion of the sac, especially if small, first proposed by Hahn[11] and later mentioned by Morton and described in detail by Ferguson and Cameron;[6] (3) opening the duodenum, inverting the sac and amputating it from within, as suggested by Maclean;[12] and (4) opening the duodenum, curetting the mucosal lining of the sac, thus obliterating it, and closing its neck from within, as performed by Finney.[7]

The principal postoperative complications of the direct attack were due to injury to the adjacent pancreas, causing either fatal acute hemorrhagic pancreatitis, pancreatic fistula, peritonitis or meteorism.[3] In Finney's case, death was attributable to the drug used in the control of the distention.[7] Others also have observed very troublesome vomiting and distention postoperatively after removal of these lesions.[10] This occurred in our second case. Injury to the common bile duct was noted by Pearce.[18] Complete obstruction of the duodenum on the sixteenth postoperative day occurred in our Case III, following the resection of an inflammed diverticulum in the second part of the duodenum. Gastroenterostomy was performed at that time and a rapid recovery ensued. However, Mahorner, in his reported series of eight operated cases, had four in which multiple diverticula were excised or inverted without serious complications.[13] McQuay resected two large diverticula, both as large as hen's eggs, one in the second and the other in the third part of the duodenum without complications and with relief of symptoms.[15] Reynolds inverted several diverticula in his patient with good results.[19]

At times the diverticula are difficult to find at operation. In order to facilitate the location of the diverticulum, air had been injected into

the duodenum after occlusion of its ends by Walzell,[21] and Mahorner and Kisner.[14] Ferguson and Cameron gave their patients a glass of bismuth to drink the night before operation, which made the diverticula more readily discernible.[6] Drainage after excision of diverticula has been occasionally employed. Morton, in his series, found that 12 per cent of cases were drained.[17] In patients with perforation, it is obviously indicated. It was interesting to note that in Case 5 of Glasier and Corbett, in which a cigarette drain was placed down to the pancreatic bed after resection of a large diverticulum of the third portion, clear, colorless, pancreatic secretion drained for six weeks.[8] The accumulation and local irritation of such secretions may be the reason for the frequent and distressing paralytic ileus so commonly encountered after removal of diverticula, and perhaps drainage should be resorted to more frequently. We were tempted to employ drainage in our second case but did not do so. The ensuing ileus was very disturbing to us.

Our experience with sidetracking alone in our first case of multiple diverticula was disappointing. Aware of the hazards of direct attack, as in our second case, wherein three large diverticula were present, we resorted to a combination of two methods. By diversion of the alimentary stream we hoped to reduce the danger of pancreatitis and leakage. The wall of one of the diverticula was thin, very friable and acutely inflamed. While closure appeared satisfactory, it was feared that infection might jeopardize the result. Severe distention due to ileus did develop on the fourth postoperative day, but was controlled with antibiotics reinforced with ACTH. We do not know whether the ACTH merely made the antibiotic more effective in the control of a local infection or whether it had a specific effect on the motility of the bowel and the shift of fluid from the so-called "third compartment," that is, from the interior of the bowel into the intra- and extracellular compartments. From experience with the use of ACTH in other cases we strongly suspect that it may be a valuable agent in the treatment of paralytic ileus. In our Case III, sidetracking was done to relieve an obstruction which developed in the second portion of the duodenum after excision of one of two large diverticula. The second diverticulum was not excised, and in spite of this the patient has been well for seven years.

CASE REPORTS

CASE I. L. L., a forty-five year old white housewife, was first seen on February 13, 1953, complaining of stomach trouble and indigestion which had been present since the age of eighteen. This consisted of a dull, aching and burning epigastric pain which radiated through to her back. Soda, taken frequently, relieved this slightly. She belched gas considerably, but without relief. The type of food ingested had no effect upon it, and even when she went without eating the distress was considerable. The pain had become progressively worse for the past ten years and had been especially troublesome for the last five years. For three years she had had attacks of vomiting about an hour after meals. These attacks occurred several times a month and would last from three to four days. At no time had she vomited old food or blood. With the vomiting spells, diarrhea would develop and she would pass watery stools every two hours. Between the spells of diarrhea, slight constipation would be present for a day or two. No blood or mucous had been noted in her stool. Two years previously she had had a very severe attack of similar pain and appendectomy had been performed. Her appetite had been poor and she had lost four pounds in the past year; her recent weight was 115 pounds. She smoked five cigarettes a day. She was married and had two children. Her periods had recently become slightly irregular, but otherwise she had no menopausal symptoms. At the age of three, she had had typhoid fever.

Examination revealed a thin, white woman with a normal temperature and pulse. Blood pressure was 120/70. Findings were negative except for tenderness across the upper abdomen. There was no rigidity or palpable mass. An upper gastrointestinal series revealed three diverticula, two of which were moderately large. (Fig. 2.) One arose in the perivaterian area from the concave side of the duodenum. It was about 3 cm. in diameter and had a wide neck. A smaller diverticulum was about half this size. It arose from the concave aspect of the duodenum at the junction of its descending and third portion. A third large diverticulum, about the size of the first, arose from the upper surface of the third portion of the duodenum. The tenderness in the abdomen was in the vicinity of the diverticula. After a long period

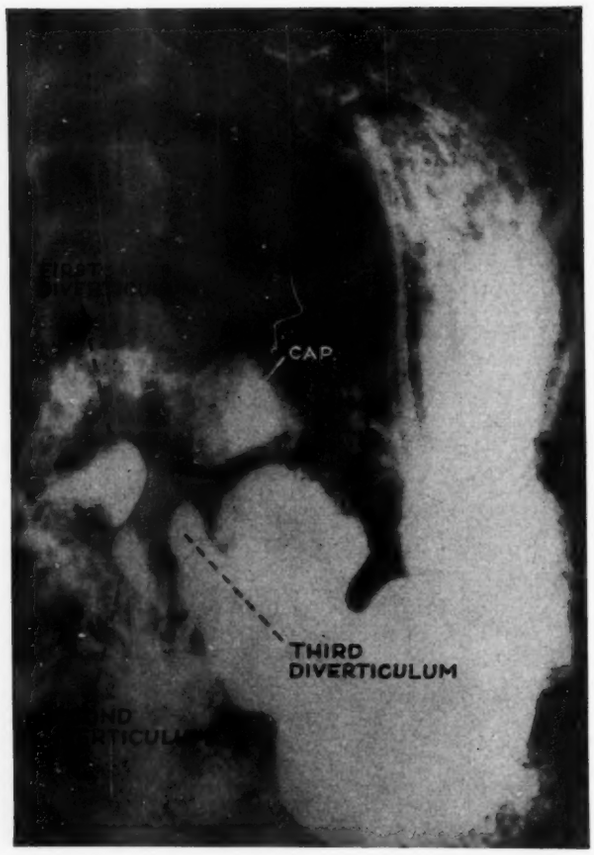

FIG. 2. Case 1. Three diverticula of the second and third parts of duodenum. Sidetracking operation resulted in failure.

of intensive conservative care without relief, operation was proposed and accepted.

On March 6, 1953, a sidetracking operation was performed. The duodenum was severed just distal to the pylorus, and the proximal end of the duodenum was closed and buried in the head of the pancreas. About half of the stomach was resected and a loop of jejunum was brought up anterior to the colon. The end of the stomach was anastomosed to the side of the jejunum. An uneventful recovery ensued and the patient left the hospital one week later. At first she was distressed, although she ate small amounts and occasionally would vomit. Even after a month, regardless of kind or amount of food, nausea was present for one to two hours after meals and would be relieved by vomiting. She still had considerable gas and a slight pain in her upper abdomen which was referred to her back. The severe gnawing pain that she had had previously disappeared. She stated that she felt considerably improved over her preoperative condition. Her bowels had been regular and no further diarrhea had occurred, although she had lost ten pounds since her operation. Physical examination still revealed a slight tenderness in the mid-abdomen. Postoperative x-rays taken showed reflux of barium into the proximal limb and partial filling of the diverticula.

In December, 1954, a follow-up report was received from her attending surgeon, stating that the epigastric pain had recurred and that nausea and vomiting had become more troublesome. X-rays had been taken of her gallbladder with intravenous dye. These had been interpreted as suggestive of stones. Exploration was performed and the gallbladder removed, although no stones were found in the gallbladder or in the common duct. The results were disappointing and the patient's symptoms continued. These were attributed to a dumping syndrome by her present medical adviser. The patient was not able to stop smoking as she was urged to do, and remained a high-strung, nervous person. She was passing through the menopause and this may have been partly responsible for the unsatisfactory result. However, diverticula of the duodenum which fill with and retain food are still present. We strongly suspect that these are the source of her symptoms. The result of the sidetracking operation in this case was decidedly unsatisfactory.

CASE II. P. S., a sixty year old white nurse, was admitted on January 29, 1955, complaining of severe, intermittent, colicky pain of ten days' duration which required repeated narcotics. Vomiting had been persistent, at times foul but never fecal and usually clear. Chills and fever up to 102.8°F. developed on the second hospital day and persisted for three days. On admission there was moderate deep epigastric and right upper quadrant tenderness. There was no rigidity or palpable mass.

Laboratory data was as follows: red blood count, 4,410,000 with 102 per cent hemoglobin; white blood count, 13,200 with 88 per cent polymorphonuclears; serum amylase, 39 units.

The pain subsided on the third hospital day and the patient began to take liquids and later a soft diet. Gradual improvement occurred until the eleventh day when severe epigastric pain and vomiting recurred. The temperature remained normal. After two stormy days opera-

tion was advised and accepted. X-rays with dye taken on the ninth hospital day showed a normally functioning gallbladder without stones. An upper gastrointestinal study on the tenth day revealed three large diverticula of the duodenum which were tender on palpation; one retained barium for more than six hours. (Fig. 3.) The patient stated that she had had bilious spells since childhood. Her first attack of severe epigastric pain, which radiated to her back and was associated with vomiting, occurred in 1941. Jaundice had never been noticed. Loose stools would occur at times and large, foamy, yellow stools were occasionally passed. She had had repeated attacks similar to the present one at intervals since 1941. An ovarian cyst and the appendix had been removed in 1930. Complete hysterectomy had been performed in 1945 for fibroids. The patient had had frequent headaches. Her daughter died from cancer of the breast and two grandchildren by this daughter have von Recklinghausen's disease; one with bilateral neurofibromas of the chest and the other with cerebral lesions.

The preoperative diagnosis was multiple duodenal diverticula with acute diverticulitis.

At operation on February 11, 1955, a long, right rectus incision was made. Adhesions were freed, exposing a gallbladder which was about one and a half times normal size. It was thin-walled, normal in color, without palpable stones and emptied readily. The common duct was slightly enlarged, but no masses could be palpated. The right transverse colon was mobilized and retracted downward, exposing the duodenum. A large diverticulum about 2½ cm. in diameter was exposed at the junction of the first and second parts of the duodenum. It lay superficially on the anterior surface of the pancreas and was readily dissected free. Its walls were about the thickness of the normal duodenum, and were loosely attached to the adjacent pancreas. The peritoneum to the right of the second part of the duodenum was incised and the duodenum and head of the pancreas turned medially. Immediately, a large diverticulum was noted along the lateral edge of the lower portion of the second part of the duodenum. This was about 5 cm. in diameter and appeared to be attached to the duodenum by a wide neck. It was exceedingly thin-walled. After being dissected free, it was grasped with the thumb forceps which caused it to rupture. Considerable fresh bile escaped. The contents, which consisted of old food and barium, were evacuated. The adjacent parts of the head of the pancreas looked slightly edematous but otherwise normal. The walls of the diverticulum were then excised back as far as normal-appearing duodenal wall, leaving a short cuff. The duodenum was closed transversely using an inner line of interrupted No. 00 chromic catgut sutures with the knots in the lumen of the duodenum. It was reinforced by a layer of mattress sutures of No. 000 black silk. The duodenum was then allowed to drop back in its normal position. The diverticulum, described previously at the junction of the first and second parts of the duodenum, was resected and closed vertically in the same manner. The transverse colon was elevated and the ligament of Treitz was exposed and severed. The fourth part of the duodenum and the first part of the jejunum were dissected free, exposing a large diverticulum about 4 cm. in diameter protruding upward from the terminal duodenum for a distance of about 2½ cm. It too lay superficially in the anterior surface of the body of the pancreas. It was easily excised and closed in the same manner as the other two diverticula. The thickness of the wall of this diverticulum was approximately the same as that of the adjacent bowel. Because of the hazard of rupture or infection of the suture lines in the duodenum, the walls of which were friable due to recent infection, it was thought advisable to divert the alimentary stream. Partial gastrectomy was performed, resecting about two-fifths of the distal stomach. A loop of jejunum was brought upward and the end of stomach anastomosed to the side of the jejunum. In order to minimize the back pressure of bile in the proximal loop, an additional jejunojejunostomy was performed between the afferent and efferent loops. The abdomen was then closed without drainage. The patient's immediate postoperative condition was excellent. On the second postoperative day the pulse suddenly rose to 160, and some pain in the right chest and a fever of 102°F. developed. Dullness in the right lower chest was noted. X-rays revealed atelectasis of the right middle lobe.

On the third postoperative day the abdomen became distended and peristaltic sounds were markedly diminished. Measures to re-expand the right lung were gradually effectual. The

FIG. 3. Case II. Three diverticula: (1) at junction of first and second parts of duodenum; (2) large, perivaterian diverticulum; (3) diverticulum arising from superior border of distal third part of duodenum. All were resected and a sidetracking operation was performed. A good result was obtained.

abdominal distention gradually disappeared. It was believed that ACTH given in 25 mg. doses every eight hours, in addition to the antibiotics, was helpful in its control. On the eighth day the patient began to take food and pass gas rectally. A severe productive cough occurred which gradually improved. The patient was dismissed from the hospital ambulatory on the twenty-first postoperative day. Since then a gradual improvement has occurred and she now feels very well. She has been free from pain and distress, has a good appetite, and is concerned about gaining weight.

CASE III. A. S., a forty year old cabdriver, entered the hospital on November 21, 1948, complaining of dull, cramp-like, right abdominal pain, localized opposite the umbilicus, of one year's duration. The pain was intermittent and was not related to the type of food or to the time of meals, except that fats seemed to cause some nausea. At times he had a chilly feeling, but no fever. The bowels were normal. He had gradually lost about 16 pounds over a four-year period; his weight on admission was 129 pounds. While in the Army in 1945, after taking atabrine®, a painless jaundice developed. Otherwise he had been well except for measles and a tonsillectomy in childhood. His family history was irrelevant.

Examination revealed a thin, wiry man who appeared tense. There was no tenderness, masses or rigidity of the abdomen. The liver and spleen were not enlarged. Roentgenographic examination revealed a large gallstone, visualized only with the dye in a large pendulous gallbladder; and two large diverticula of the duodenum, one in the second and the other in the third portion. Both retained barium after six hours, although the stomach emptied normally. Laboratory findings were as follows: red blood count, 4,280,000 with 14.8 Gm. hemoglobin; white blood count, 8,100 with 71 polymorphonuclears, 3 eosinophils and 26 lymphocytes. Urinalysis gave a negative result.

After one year of intensive medical treatment without improvement, it was decided to remove the gallbladder and resect the larger of the two diverticula which arose from the concave side of the second part of the duodenum.

On November 22, 1948, an incision 1 cm. to the right of the midline from costal margin to umbilicus, was made. A large gallbladder with slightly thickened walls and few adhesions about it, containing a large stone, was removed. The peritoneum to the right of the second part of the duodenum was incised. The duodenum was mobilized and rotated medially, exposing a large, thin-walled diverticulum arising from its posterior and medial aspect. The diverticulum was excised, leaving a short cuff which was sutured transversely with an inner layer of No. 000 chromic catgut and reinforced by interrupted No. 000 black silk sutures. The gallbladder region was drained with a No. 22 catheter brought out through the upper end of the incision.

The postoperative course was stormy. A fever of 100 to 102°F. rectally was present for the first week. Upon removal of the Levin tube on the fourth postoperative day, vomiting developed, persisted and gradually increased in severity. X-rays on the eighth postoperative day showed a marked narrowing of the second portion of the duodenum. On the sixteenth postoperative day posterior gastroenterostomy was performed. Convalescence thereafter was rapid and uneventful. The patient, followed

up to date, has been in good health and asymptomatic.

Comment: While the cholecystectomy may have accounted for this patient's relief, we believe that the removal of the one large diverticulum, which had a narrow neck and retained barium, also contributed to it. Infection about the operative site in the duodenum resulted in duodenal obstruction, requiring gastroenterostomy. This also may have favorably affected the remaining diverticulum in the third part of the duodenum, or this diverticulum may have been an asymptomatic one for it had a wider neck. The points that it may not be necessary to remove all multiple diverticula to obtain relief, and the high incidence of associated gallbladder disease with duodenal diverticula are well illustrated in this case.

COMMENTS

When multiple large diverticula are noted in a patient with symptoms attributable to the diverticula alone, such symptoms may be due to only one or two of these. We believe this was so in Cases II and III of our series. The particular diverticulum more apt to cause the trouble in most cases was the one located near the ampulla of Vater in the second part of the duodenum. Mahorner reported a case in which several diverticula were resected with relief of symptoms, only to find on follow-up study that two overlooked diverticula were still present and asymptomatic. However, the excision of all diverticula may not be extremely difficult. In Case II, three large diverticula were readily excised.

Further experience may prove that a procedure of such magnitude, as employed in Case II, is unnecessary and that merely keeping the stomach empty with a Levin tube will obviate the necessity of diversion of the alimentary stream after direct excision or inversion of the diverticula. Inversion of the sac rather than excision may prove to be the safest method, especially if the diverticula are small and uncomplicated. Obviously inversion would be unsuitable if polyps, ulcers or tumors were present or suspected in the diverticula, as described in Lindner's patient who bled. Concern has been expressed that inversion of the sac may lead to the formation of a polypoid lesion within the duodenal lumen. No such cases have as yet been observed or reported. Dunstan, employing Maclean's suggestion, reported one successful case in which the duodenum was opened, a large diverticulum of the third portion inverted into the lumen, the neck closed with transfixion sutures and the diverticulum amputated from within.[5]

While the indirect or sidetracking method of dealing with diverticula may be inadequate, it may prove to be a useful adjunct to the direct attack. Its employment may minimize or eliminate the troublesome and at times fatal complications following direct removal of diverticula in difficult cases, particularly when multiple or severely inflamed lesions are present.

CONCLUSION AND SUMMARY

The reports in the literature of the results of various methods of surgical treatment of multiple duodenal diverticula are reviewed and three case reports are added. In Case I diversion alone resulted in failure. In Case II, three large diverticula were excised and a sidetracking procedure added. After a stormy postoperative course an excellent final result was obtained. In Case III, only the largest of two diverticula was excised. Obstruction of the duodenum at the site of its excision required gastroenterostomy. The patient has been in good health and asymptomatic for seven years.

Our findings then would tend to confirm the prevailing opinion of the majority of surgeons that sidetracking, by-passing or diversion procedures alone are inadequate in the treatment of single or multiple diverticula. However, in difficult cases complicated by inflammation, we believe that its use as an adjunct to the direct attack on the diverticula may be advantageous in some instances and tend to reduce the troublesome complications associated with excision or inversion procedures. When all other causes or symptoms have been excluded and medical treatment has failed, we believe that patients with multiple diverticula with symptoms sufficiently severe should be given the benefit of surgical treatment. The diverticula should be excised or inverted if small, and a sidetracking procedure added if obstruction or leakage is apt to occur. The use of antibiotics and other adjuncts such as ACTH will undoubtedly result in a lower mortality than in the past.

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The Pre- and Postoperative Management of Patients Undergoing Miles' Resection

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THE combined abdominoperineal resection for carcinoma of the rectum, first described by Miles in 1908, has been widely accepted by the majority of surgeons who treat this lesion because it has been demonstrated that this procedure offers the patient the best chance of cure. The technic of the operation has been well standardized and in brief consists of the excision of the rectal lesion by means of a combined intra-abdominal and perineal approach together with the establishment of a permanent colostomy. Because of greater technical improvements the scope of this operation has been increased, and today it is successfully accomplished in a very high percentage of all patients presenting themselves with this type of malignancy. It has long been realized that good pre- and postoperative management is a *sine qua non* for a successful outcome and has been materially responsible for decreasing the mortality and morbidity of this extensive technical operative procedure.

The purpose of this paper is to outline what we believe are the important factors in preparing the patient for a Miles resection and in taking care of him postoperatively. Some of this routine was learned while we served our apprenticeship at the Lahey Clinic, Boston, Massachusetts.

PREOPERATIVE MANAGEMENT

Although one should strive to excise the lesion as soon as possible, the physical and chemical status of the patient must first be properly evaluated, and he must be hospitalized for a few more preoperative days so that he can be brought into the best possible state relative to his nutritional, fluid, electrolyte and vitamin balances. Great pains must be taken to prepare the bowel properly so that not only is it mechanically cleansed of feces but also the bacterial count is reduced to a minimum.

Because of the nature of the lesion, the age group and the shock of this extensive operation, almost all of these patients may be classified as poor surgical risks; therefore, the degree of risk must be estimated by a careful medical evaluation. At this time the status of the lungs, heart, liver and kidneys must be appraised by appropriate examinations, and if any abnormalities exist, they should be properly treated by a competent internist.

The anesthetist should interview the patient before the operation so that by a thorough evaluation he will be able to select the anesthesia best suited to the patient. This preoperative interview is being practiced more and more today and has paid dividends in preventing unforeseen complications during the operation. In the majority of patients continuous spinal anesthesia is the procedure of choice.

A study of the patient's red blood count, hemoglobin and hematocrit will reveal whether or not he is anemic. Enough blood should be administered to increase the red count to about 5,000,000 and the hematocrit to about 45 per cent. The most accurate means of restoring blood volume is to perform such studies and determine the actual amount of blood that must be given to restore the normal level.

Adequate vitamins are given in the form of vitamin B complex and ascorbic acid intravenously or intramuscularly each day before the operation. Vitamin K, about 9 mg. daily, is given intramuscularly, particularly if the patient has been on a long regimen of sulfathalidine® or if the prothrombin is below normal. Four units of blood (2,000 cc.) are ordered in reserve for the operation.

Colonic irrigations of soapsuds or saline are ordered twice daily. It is particularly specified

that the returns should be clear after each irrigation. One and a half ounces of magnesium sulfate is given by mouth on the morning of admission. However, if obstruction is present, this preparation is not given. If partial obstruction is present, then a smaller dose (½ ounce) is administered. The patient is placed on a high protein, high caloric, low residue diet and is given intestinal antiseptics by mouth such as sulfathaladine, 2 gm., four times a day, or oral streptomycin, ½-gm. every twelve hours. These antibiotics are given forty-eight hours prior to surgery. Of late we have dispensed with sulfathalidine and streptomycin and use only neobacin®* tablets. This medication is a combination of neomycin and bacitracin and ensures potency against a wide spectrum of intestinal organisms. Clinical studies have shown that neomycin is highly effective within twenty-four hours against the coliform bacilli, hemolytic and non-hemolytic streptococci, proteus and pseudomonas organisms.[5] Studies have also shown that oral bacitracin is effective against the entire group of intestinal gram-positive cocci, including anaerobic cocci, as well as against Endamoeba histolytica. The combination of neomycin and bacitracin has augmented the action of both drugs and is today one of the most potent intestinal antiseptics.[6] The bowel can be effectively sterilized within twenty-four to forty-eight hours by the use of oral neobacin tablets. Four tablets are given every four hours over a period of two days until the day of surgery. Within twenty-four to forty-eight hours bacterial counts in the colon are at a level low enough to allow surgery.

A Miller-Abbott or Harris intestinal tube is passed twelve hours prior to operation in patients without obstruction and several days before surgery in patients with partial obstruction. Its greatest importance in both types of patients is its effect in telescoping the loops of small bowel on the tube, and thereby creating more space within the peritoneal cavity to perform the intra-abdominal portion of the procedure with greater ease. It also avoids postoperative distention of the small bowel. A Foley catheter is placed within the bladder in order to allow for continuous closed drainage both during the operative procedure and postoperatively, as the bladder is denuded of some of its nerve supply.

* A product of Commercial Solvents Corporation, New York, New York.

Non-protein nitrogen, serum protein and serum chloride tests are performed routinely in addition to the usual complete blood count and urinalysis.

POSTOPERATIVE MANAGEMENT

Immediately following operation, the patient is taken to a recovery room where postoperative care is initiated. Oxygen, 8 L. per minute, is administered either by nasal catheter or mask. Oxygen aids in decreasing the nitrogen content of the body and therefore decreases the degree of gaseous distention of the bowel. Postoperative atelectasis should be guarded against by frequent deep breathing exercises. If atelectasis should occur, we do not hesitate to call in a bronchoscopist to bronchoscope the patient and aspirate mucus from plugged bronchi. If atelectasis appears to be of the segmental variety, we have had excellent results with the use of alevaire®* aerosol inhalations. The lower extremities are moved and exercised frequently in order to minimize the possibility of venostasis with ensuing phlebothrombosis or thrombophlebitis. Ace bandages are routinely ordered for both lower extremities.

The patient is returned to his room after the pulmonary circulatory symptoms have become stabilized, and attention is directed to fluid balance. An accurate intake and output chart should be made so that one will know at a glance the status of the fluid balance. A safe rule to follow is to give enough fluids to make up for that lost by respiration, or insensibly through perspiration or through Wangensteen suction, and still insure a urinary output of at least 1,000 cc. daily. A four-hour chart of temperature, pulse and respiration should also be kept.

The day following operation, a complete blood count and determinations of hemoglobin, hematocrit, serum protein and chlorides are ordered. If the red blood count and hematocrit are low, they should be brought to normal by the immediate administration of blood. For the first twenty-four hours, the administration of salt in intravenous fluids is avoided as it has been amply proved that salt is not well metabolized in the immediate postoperative period.[2] Multivitamins, including at least 500 mg. of ascorbic acid and one ampoule of vitamin B complex, are given in one of the intravenous

* A product of Winthrop Laboratories, New York, New York.

fluids daily. The administration of multivitamins and vitamin C is continued by mouth as soon as the patient is allowed a diet.

The lower extremities must be observed daily for evidence of phlebothrombosis or thrombophlebitis. When varicosities have appeared in the lower extremities, we have applied compression bandages immediately following operation. We believe that this latter procedure serves to maintain a better circulation, obviates venostasis and reduces stagnant venous columns. If there is any suspicion that there may be a silent thrombus in the lower extremities, the patient should be placed on anticoagulant therapy immediately. We start anticoagulant therapy with intramuscular heparin for its immediate effect, and continue with dicumarol.

Inasmuch as urinary complications are the rule rather than the exception, one must treat them vigorously and not hesitate to consult a urologist to cope with this complication. The bladder becomes hypotonic and is unable to function properly because during the separation of the rectum from the pararectal supports, the sympathetic preganglionic fibers supplying the bladder are usually destroyed. The bladder should remain constantly decompressed for at least seven days to regain its former intrinsic tone and propulsive qualities. During this time a self-retaining Foley bag is kept in place with closed bladder drainage and frequent bladder irrigations. On the seventh postoperative day the catheter is removed and a urinary specimen is sent to the laboratory for examination. The patient is allowed to void during a twelve-hour period and a catheter is inserted in case of retention. If more than 4 ounces of residual urine exists, the catheter is replaced for several more days. It may even be necessary in some instances to discharge the patient with a catheter in place until the residual urine is completely eliminated. If the residual urine is complicated by prostatic hypertrophy, it may be necessary for the patient to have a transurethral resection.

The perineal dressing is changed frequently, and the rubber tissue drain (Penrose cigarette drain) is removed on the fourth postoperative day. The colostomy is decompressed in twenty-four to thirty-six hours with a soft No. 14 or No. 16 French catheter, making sure that the catheter is inserted below the level of the peritoneum. The catheter is allowed to remain in this position for three days. The original anterior colostomy dressing is not disturbed for six days. After decompression, a soft solid diet without fruit or vegetables is ordered.

On the third postoperative day the patient is allowed to be ambulatory at frequent intervals.

On the fourth postoperative day both the colostomy catheter and the colostomy clamp (Ochsner) are removed, as is the perineal rubber tissue drain (Penrose cigarette drain).

On the fifth postoperative day milk of magnesia (2 teaspoonfuls every hour for three successive doses) is given, and on the following day the original colostomy dressings are changed. On the same day perineal irrigations are started and carried out three times daily, using 1 teaspoonful of iodine to 1 quart of saline or a sulfonamide solution of 1:1,000. Anterior colostomy irrigations are begun on the seventh postoperative day and repeated every other day. Colostomy diet 1 is started at this time. This diet is used while the patient is first gaining control and at any time when loose movements occur.

COLOSTOMY DIET 1

Breakfast

Large portion of cream of wheat with boiled milk, sugar if desired, two hard-boiled eggs, dry toast, one glass of boiled milk

Lunch

Creamed soups (creamed lettuce soup three or four times a week), creamed fish or meat, baked or mashed potato, boiled rice or custard

Dinner

Meat or fish, creamed whenever possible, escalloped vegetables (no spinach or carrots), soft pudding, custard or junket

On the ninth postoperative day Sitz baths, three times daily for periods of twenty to fifty minutes, are started and perineal irrigations discontinued.

On the tenth postoperative day colostomy irrigation instructions are given to the patient by his nurse and the patient is given typewritten instructions as to the management of his colostomy. The following list is a copy of one of the typewritten instruction sheets given to each patient before he leaves the hospital at the Lahey Clinic.

INSTRUCTIONS FOR COLOSTOMY PATIENTS (LAHEY CLINIC)

Colostomy is necessary for some patients in order for them to be well. At first thought it may seem to be an intolerable condition, but it need not be a nuisance nor as unpleasant as commonly believed. With proper care the bowels can be regulated so that there is no unpleasant odor about the patient's body or clothing, and the bowel movements can be satisfactorily controlled to move at a convenient time. The following instructions have been carefully worked out to make the care and control of the colostomy as easy as possible: (1) The diet is regulated (see colostomy diets 1, 2 and 3). (2) Irrigations or enemas of the colostomy are employed. (3) A regular time is chosen for the enema.

It is particularly important to realize that when colostomy is present, moderate constipation is to be desired; a bowel movement only every second or third day does not interfere with health. The bowels should move only at the time of the irrigation.

The following equipment is necessary and should be procured before leaving the hospital (the nurse in charge of the ward will attend to this): a 2-quart enema bag, 4 feet of connecting hose with shut-off glass adapter, and a No. 22 to 26 French catheter. Warm water from the faucet can be used for the irrigation, and soapy water can be substituted if an unsatisfactory result is obtained.

The enema bag with the 2 quarts of warm water can be fastened about 4 feet above the floor. If abdominal cramps are too severe, it can be lowered. The patient can be on his side, or he can stand or sit. The catheter is greased and inserted for a distance of at least 6 inches or full length, if this can be done without discomfort. At times insertion will be difficult. When this occurs, the catheter should be pushed in while the water is running. The apparatus is connected up and the water allowed to flow at a speed consistent with comfort. This speed can be regulated by the height of the bag and the shut-off, as too rapid a flow will cause distention of the bowel which produces distress or pain.

After the bowel feels quite full, if the fluid has not already begun to flow from the colostomy, the catheter should be removed and the fluid and feces will be evacuated. A pan or pail is firmly pressed against the abdominal wall below the colostomy and held obliquely so that even with forcible dejection all water and fecal matter is caught. If an unsatisfactory fecal result is obtained, the irrigation can be repeated with 2 additional quarts two or three times. Sufficient time should elapse to allow the return of all fluid. Some patients find the standing position best for elimination after their irrigation.

For a period of two months irrigations should be taken every second or third day, either morning or evening depending on the patient's preference. The evening seems preferable since a pad of absorbent material can be left over the colostomy that night to catch any returned water. Each patient can work out the most convenient time. During this two-month period colostomy diet 2 should be followed. This diet is used after control is gained in the hospital (two weeks), and continued for two months at home.

COLOSTOMY DIET 2

Cream of wheat, puffed wheat or puffed rice
Eggs: boiled, poached, baked or scrambled
Oven-broiled bacon
White bread: plain or toasted
Plain white crackers or saltines
Butter, cheese, milk, tea, coffee, cocoa
Boiled rice, baked macaroni or spaghetti
Baked custards
Soups of all kinds, except tomato or corn
Potatoes: baked, mashed or riced
Broiled steak or lamb chops
Fish: broiled, boiled or creamed
Sponge or angel cake

After two months irrigation can be taken every third day and colostomy diet 3 can be added to diet 2 if control is still effective.

COLOSTOMY DIET 3

Raw lettuce and celery
Cooked string beans, carrots, beets, winter squash, peas, cauliflower or asparagus
Cooked fruits, orange juice

The patient will be able to tell that certain foods interfere with control, and these should be eliminated. Most patients with colostomy have trouble with green corn, baked beans and fried foods.

If there is any fecal discharge from the colostomy at times other than following irrigation, 1 teaspoonful of paregoric can be taken at each discharge. If the bowels become loose due to other causes, colostomy diet 1 should be followed for a few days. No cathartics, laxatives or oil should be used.

The patient should be properly instructed by the nurse in performing these irrigations before leaving the hospital. A patient can readily take care of a colostomy unaided when he gains confidence. A colostomy bag or apparatus is not necessary. The colostomy can be covered with a piece of gauze, cloth or soft paper held in place by a small elastic belt or adhesive.

The pad can be changed twice a day. Some patients choose to wear a bag until they gain confidence in control. A considerable number of people find it necessary to adjust themselves to a colostomy. However, as they approach this problem of adjustment they will be encouraged to know that many people continue to carry on their jobs and activities in manual labor, office work, sports, various professions and social activities with a minimum of inconvenience.

The colostomy should be kept covered with a gauze pad over which a cellucotton should be placed (or oiled silk). For female patients, a girdle or garter belt will hold the covering in place. Absolutely nothing shows or is the least bit bulky.

SUMMARY AND CONCLUSIONS

1. The importance of good preoperative and postoperative care in the final outcome of Miles' resection is emphasized.

2. Preoperative and postoperative management is reviewed and enumerated.

3. Various colostomy diets from the Lahey Clinic for initial and ultimate control of bowel function are given.

4. Instructions for the management of colostomy by the patient is considered in detailed fashion.

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Calcium Content of Rarefied Bone

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CONCEPTS vary as to the mineral content of bone following trauma or disease. Frequently a resulting change is rarefaction. The latter is described by Baker[1] as osteoporosis or deossification, and by Leriche and Policard[2] as osteolysis, decalcification or demineralization.

It is agreed that bone is formed in two stages. After the protein matrix of bone is laid down, mineralization of this organic substance takes place, thereby transforming it into true osseous tissue. According to histologic evidence, bone destruction takes place in one stage, i.e., osteoclasts destroy both the organic and inorganic fractions of bone *in toto*. If this be the case, the rarefied bone as seen on the radiograph is lessened in amount. On the other hand, there is another point of view that the mineral content of bone may be removed following disease or trauma as a result of local hyperemia. This implies that bone is like a bank from which minerals may be deposited or withdrawn as suits or is forced upon the depositor.

This investigation was undertaken in an effort to resolve the foregoing, using as nearly as possible a mathematic approach rather than impressions gained from histologic or radiographic preparations.

METHOD OF STUDY

The animals used for this investigation included seventeen guinea pigs. The animals were rendered insensitive to pain by the intraperitoneal injection of sodium pentobarbital. The right hips of fifteen of the animals were traumatized, fractured or dislocated by forced abduction of the flexed thigh. The left hips were used as controls. The animals were then sacrificed at varying intervals up to 180 days. The femurs were dissected and radiographed together so that any differences of rarefaction could be determined. (Fig. 1A to F.) Changes in density of bone were apparent with the animals of eight days and continued for 112 days. Differences were noted either in the trochanter, head or both. The two additional animals provided eight more sections of bones. Thus there were thirty-eight pieces, fifteen femoral heads and fifteen trochanters from traumatized hips, and four trochanters and four heads from normal hips. The femoral heads and trochanters were then prepared for chemical analysis.

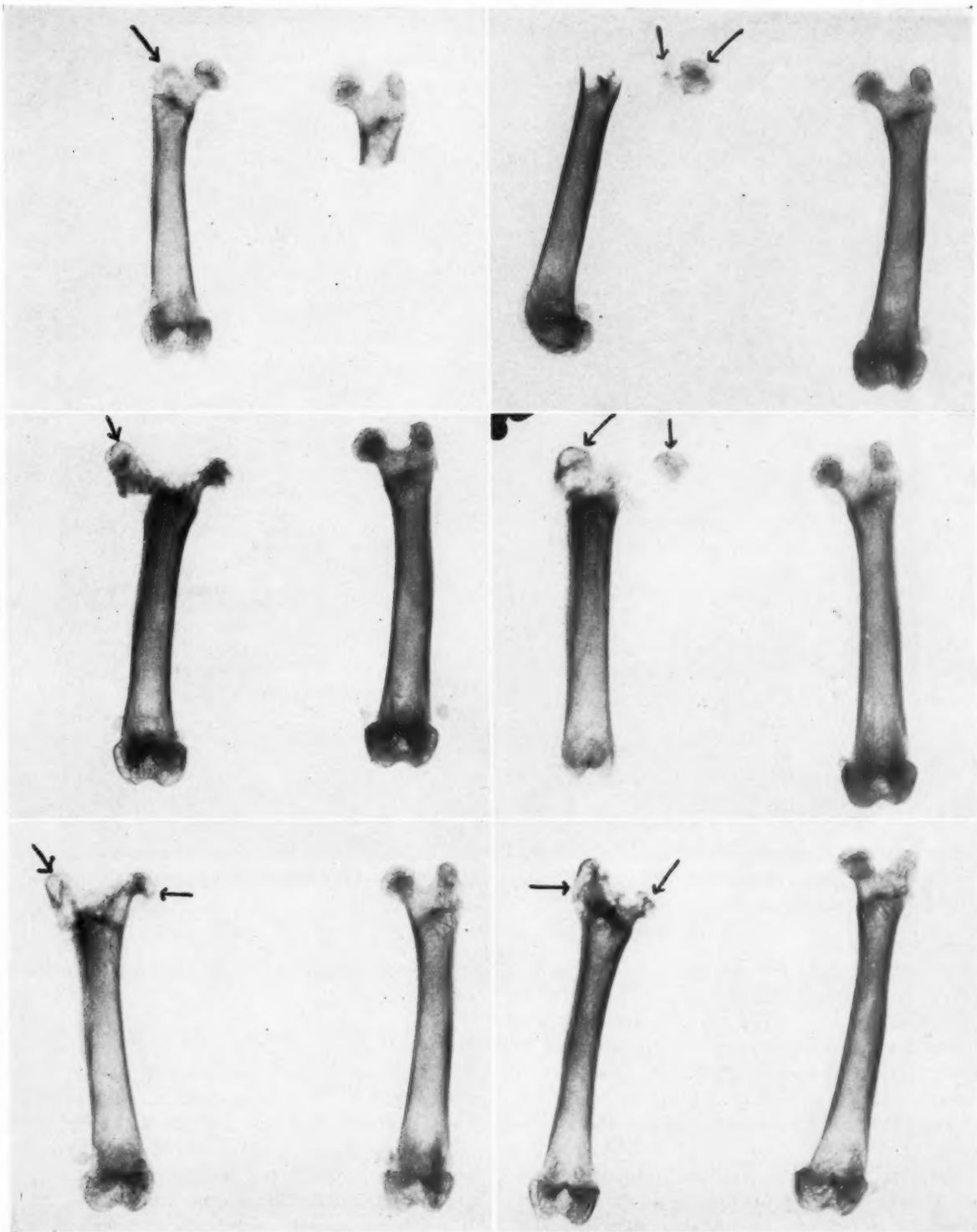
Each specimen of bone was cartilage-free and prepared by being subjected to 650°C. temperature for six hours. The weights of the ashed bones varied from 15.1 to 95.1 mg. The versenate method was used for the determination of calcium.

Principle. Salts of ethylenediaminetetraacetic acid form very stable soluble chelates with calcium and magnesium according to the following reaction:

$$Na_4Ver + Me^{++} = Na_2MeVer + 2Na^+$$

An azo dye, Eriochromeschwartz T, has the ability to form a colored complex compound with magnesium. This complex is broken down by versene to form the more stable versene magnesium chelate. The dye itself has a deep blue color at a pH of 10. In the presence of magnesium, however, a wine red complex is formed. When versene is added to a magnesium solution containing small amounts of this dye, a sharp color change from red to blue occurs when sufficient versene has been added to chelate all the magnesium. When calcium (which does not form a stable complex with dye) is present, it is also titrated before the end point since versene will chelate first with calcium ions. Since the magnesium in the bone was assumed to be less than 0.3 per cent that of the calcium, the magnesium content was neglected, thus still being in the experimental range of accuracy.

Reagents. Buffer solution: Mix one part of



1A 1B 1C 1D 1E 1F

FIG. 1. The arrow points to the area of bone which has undergone change. The left femur or control is also shown. A, eight days following trauma; B, eighteen days; C, thirty-six days; D, forty-three days; E, forty-nine days; F, 112 days.

FIG. 2. A section of rarefied or osteoporotic bone demonstrates thinning of the trabeculae and widening of the trabecular spaces.

1.0 molar NH_4Cl and five parts of 1.0 molar NH_4OH to obtain a solution of pH just over 10.

Standard calcium chloride: Dissolve 1.000 gm. of pure $CaCO_3$ in a minimum amount of dilute HCl. Neutralize with NH_4OH until slightly alkaline to litmus. Dilute to 1,000 ml.

Indicator: Inhibited versenate is the indicator.

Standard versenate solution: Dissolve 4.00 gm. analytical reagent disodium dihydrogen versenate dihydrate in water containing 0.5 gm. of NaOH. Add to this solution 0.100 gm. $MgCl_2 \cdot 6H_2O$ in water and dilute to 1 L. Titrate this solution according to the procedure given hereafter, using 50 ml. of the standard calcium solution. Add enough water to the standard versene solution so that 1 ml. of versenate is equivalent to 1.00 mg. of calcium carbonate.

PROCEDURE

Pipet 50.0 ml. of the solution to be tested into a 250 ml. Erlenmeyer flask. Add 10 ml. of the buffer solution and 3 drops of the indicator. Titrate with standard versene solution to a color change from red to blue. To obtain calcium carbonate, divide the number of milliliters of versenate solution required by the weight of the sample and multiply by 100 (giving percentage of $CaCO_3$).*

The results from the determination of calcium percentage of the ashed bones are listed

* Procedure according to the Bersworth Chemical Company, Framingham, Mass.

in Table 1. It should be noted that the average was 37.6 per cent calcium. The controls yielded results ranging from 36 to 39 per cent and the range of traumatized bone ran from 35.3 to 40.6 per cent.

TABLE 1

Trochanter	Per cent of Calcium	Head of Femur	Per cent of Calcium
Tx1*	36.0	Hx1	38.3
Tx2	37.0	Hx2	36.8
Tx3	39.0	Hx3	38.6
Tx4	37.5	Hx4	37.2
T4	38.8	H4	37.2
T8	38.3	H8	39.0
T14	38.6	H14	40.2
T18	Insufficient bone	H18	40.6
T22	38.1	H22	38.5
T26	36.5	H26	38.0
T31	36.7	H31	36.5
T36	37.9	H36	37.5
T43	35.5	H43	36.0
T49	36.0	H49	35.3
T60	35.7	H60	Insufficient bone
T76	38.3	H75	37.7
T88	38.1	H88	39.4
T112	37.1	H112	36.8
T180	39.2	H180	37.9
Average....	38.4	Average....	37.8

* *Note:* The controls are indicated by x1, x2, x3, x4. T stands for trochanter and H the femoral head. The numbers show the number of days following trauma.

COMMENT

There is apparently very minimal if any change in the mineral content of osteoporotic bone following trauma. This tends to enhance the histologic evidence that there is less bone rather than diminished mineral content in osteoporotic or deossified bone. (Fig. 2.) Although this problem is a difficult one to solve, we believe the data prove that the calcium/ash ratio is constant.

SUMMARY

1. The right hips of guinea pigs were traumatized in order to produce rarefaction of bone.

2. Sections of affected bone and controls were analyzed for their calcium content.

3. The results indicated minimal change as to percentage of calcium and that demineralization of bone does not exist as a physiologic entity; hence it is concluded that osteoporosis or deossification is the correct term to describe rarefied bone.

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The Effect of Suture Technic upon the Growth of Arterial Anastomoses

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IN a previous communication from this laboratory Sauvage and Harkins[1] verified the observation that arterial anastomoses performed in the growing animal with continuous everting mattress suture, using a non-absorbable suture, invariably produce an anastomotic stricture unless the suture material breaks. These same authors also noted that when a continuous end-on coaptation suture* of silk was used under otherwise similar experimental conditions, anastomotic strictures did not occur. The difference between these two suture methods was found to be the increased length of suture material needed to complete an anastomosis with the end-on coaptation technic. The added length of suture allowed for greater expansion of the anastomosis as the suture straightened. Utilizing *in vitro* methods, Sauvage and Harkins also found that " . . . distance of the bites back from the edge did not influence the length of suture required for the everting mattress method. However, the suture length required with the end-on coaptation method varied directly with the distance the sutures were placed back from the vessel edge." On the basis of these findings, it was postulated that a narrow cuff (0.6 mm.) would provide sufficient suture length to allow for at least an 80 per cent increase in anastomotic diameter (end-on coaptation).

It is well known that two suture methods will insure enlargement of vascular anastomoses in the growing animal at a rate commensurate with growth of the host vessel. These two suture methods include: (1) absorbable suture (catgut) when used interrupted or continuous in any form; and (2) non-absorbable suture (silk) when used completely interrupted or when utilizing either of the continuous suture technics for only one-half of the circumference and interrupting the remaining sutures.

Two unanswered questions related to the growth of vascular anastomoses in the growing animal were studied in the present experiments: Will a narrow cuff (0.5, 1.0, 1.5 mm.) provide enough suture length to prevent stricture formation when performing (*in vivo*) a continuous end-on coaptation anastomosis with silk? Will a single interruption of an otherwise continuous everting mattress suture provide enough flexibility of the anastomosis to prevent stricture formation?*

METHOD

Ten weanling pigs, with an average weight of 17.9 kg., were operated upon. A 2 cm. segment of thoracic aorta was excised and sutured back into the aorta after reversing its direction. The suture technic was varied (Table 1) in performing the different anastomoses. The animals were allowed to mature at a suitable farm, and then were slaughtered and the grafts removed. The grafted segments were then inflated to 120 mm. Hg with air, and appropriate measurements, photographs and histologic sections were taken. In this manner twenty anastomoses were studied.

RESULTS

The pigs averaged a 540 per cent weight gain. All of the grafts were patent and were function-

* End-on coaptation, continuous Carrel, continuous over and over, and continuous whip stitch are synonymous terms.

* Dr. Sauvage suggested investigation of this point.

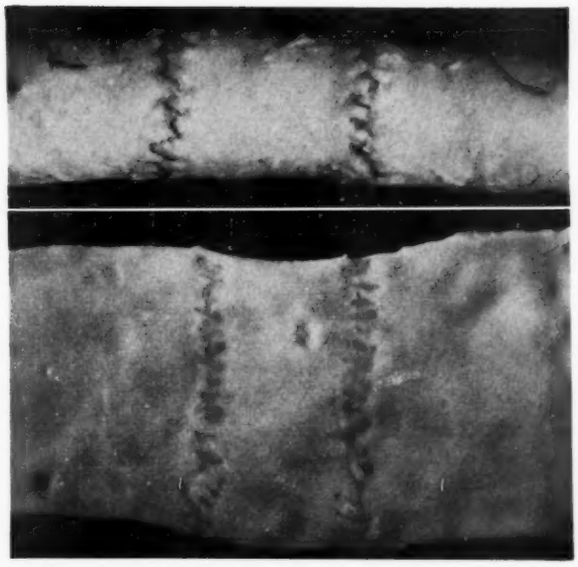

FIG. 1. *Top:* Inflated view of graft (pig 161). The anastomosis was performed with a continuous end-on coaptation No. 5-0 arterial silk suture. A 1.5 mm. arterial cuff was employed. Notice the suture straightening. There is no narrowing at the anastomosis. *Bottom:* Open view (pig 161). The intima is smooth even though there is pitting about the sutures which have been shortened and straightened with the process of growth.

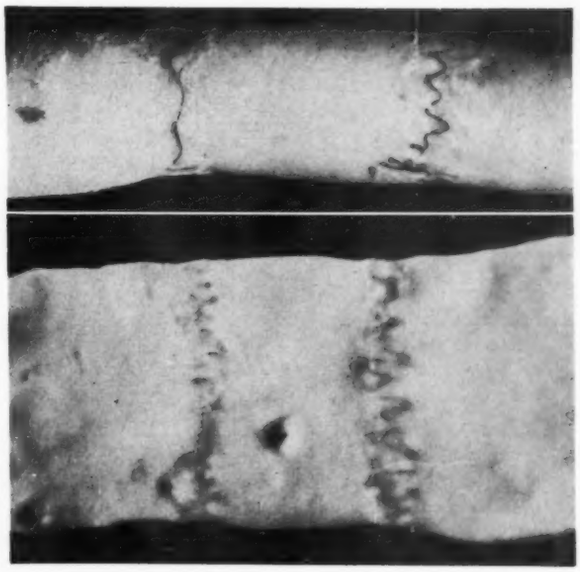

FIG. 2. *Top:* Inflated view of graft (pig 153). The upper anastomosis (left) was performed with a continuous everting mattress suture interrupted at one point. Note the intact suture has been shortened and straightened. Anastomotic growth has not been restricted. The lower anastomosis (right) was performed with a continuous end-on suture. A 0.5 mm. cuff was employed; again note suture shortening. There is no anastomotic narrowing. *Bottom:* Open view (pig 153). Suture shortening is prominent, as is arterial pitting. The intima, however, is smooth and well endothelized.

ing in a satisfactory manner as conduits of blood. A common finding was anastomotic thinning with evident suture straightening (Fig. 1.) The anastomoses were all well endothelized, smooth and free of gross degenerative change.

Microscopically the anastomoses had healed by scar tissue formation, with loss of such special tissue elements as smooth muscle and elastic tissue fibers. The arterial autografts otherwise were quite normal microscopically.

Sixteen anastomoses were completed by the continuous end-on silk suture technic. Five of these anastomoses were made with 0.5 mm. arterial cuffs, four with 1.0 mm. cuffs and seven with 1.5 mm. cuffs. All sutures remained intact and suture straightening was a prominent feature, as previously noted. The anastomoses performed with the end-on coaptation method, regardless of the arterial cuff width utilized in these experiments, kept pace in every instance with the growth of the host vessel. (Table 1.)

The continuous everting suture technic with a single point of interruption was utilized four times. Suture straightening was a prominent finding (Fig. 2), and pitting about the suture was pronounced. Anastomotic growth had occurred up to 86 per cent (Table 1); this represents only a 4 per cent average restriction in growth of this measurement.

COMMENTS

Suture technic is of importance in a growing individual when non-absorbable sutures are employed since interrupted sutures do not appear to restrict anastomotic growth whereas continuous sutures may.[2] Although the need for arterial anastomoses in growing children is uncommon, it is of interest that Hurwitt and Altman[3] have collected from the literature reports of seven patients with coarctation of the aorta upon whom surgery was performed during infancy. In all but one of these the interrupted silk or catgut suture technic was utilized. The other technic consisted of a continuous silk mattress suture used posteriorly, associated with an interrupted silk mattress suture placed anteriorly.

The postulates of Sauvage and Harkins[1] have been verified in that an anastomotic diameter (using end-on coaptation) can increase an average of 90 per cent when an

TABLE 1*

Suture Technic	Width of Cuff (mm.)	Number of Anastomoses	Average Per cent Diameter Increase			Average Ratio: Anastomosis Diameter Increase to Adjacent Aorta Diameter Increase
			Adjacent Aorta	Anastomosis	Graft	
Continuous end-on.....	0.5	5	88	90	90	1.02
Continuous end-on.....	1.0	4	80	80	82	1.00
Continuous end-on.....	1.5	7	70	72	80	1.03
Everting mattress with interruption.....	...	4	90	86	90	0.96

* Summary of data showing relationship between average per cent diameter increases in the adjacent aorta, anastomosis and graft depending on suture method. The ratios, anastomosis diameter increase to adjacent aorta diameter increase, indicate that the anastomoses in all groups of experiments were keeping pace in growth with those of the adjacent aorta in all instances to a degree quite consistent with the errors of measurement of such diameters.

arterial cuff as narrow as 0.5 mm. is employed. In no instance was there limitaton of the luminal diameter under the conditions of these experiments. Several hundred anastomoses, done chiefly upon growing animals, have been performed by the experimental workers of our group. The Carrel (end-on coaptation) technic was most often employed and no stenosis related to the suture was encountered with this method. On the basis of this general experimental vascular experience and the results of these particular experiments we believe that the Carrel technic may be more useful in patients who are growing than has been previously realized.

It is interesting that the singular interruption of a continuous everting mattress suture permitted an anastomotic growth of 86 per cent, the suture bites being taken every 0.8 to 0.9 mm. apart. Thus there was only a 4 per cent discrepancy between these anastomoses and the average growth of the adjacent aorta and the graft.

The aortic diameter of a child two and a half to three years of age is reported as one-third to one-half that of an adult.[4] It is noteworthy that this amount of growth of the child's aorta after the age of three years is only slightly more than that of pig's aortas used in these experiments (average increase approximately 80 per cent). (Table 1.) It is quite possible that if the pigs that were studied had been allowed to grow even more before slaughter, the anastomotic growth would have continued to keep pace with the growth of the adjacent aorta. Thus a pronounced growth does occur in the aorta of a child over perhaps a twenty-year period. Therefore it appears that every effort to avoid eventual anastomotic narrowing should be made when performing arterial surgery upon a child. Although our experiments show that a narrow cuff (0.5 mm.) is adequate, a wide cuff (minimum of 1.5 mm.) when used in conjunction with silk and the continuous Carrel method of suture should allow for adequate anastomotic growth under every clinical condition which might exist. Also when a nonabsorbable continuous everting mattress technic is used, even though our experiments show that interruption at a single point will give sufficient protection against anastomotic stricture formation, it might be safer to have approximately 25 per cent of the total circumference sutured with interrupted stitches.

SUMMARY

Twenty arterial anastomoses were performed upon ten weanling pigs. A continuous end-on suture was used in sixteen anastomoses. The arterial cuff varied in width from 0.5 to 1.5 mm. The continuous everting mattress suture technic was employed in four additional anastomoses, during the performance of which the suture was interrupted at one point. No narrowing of the anastomosis produced by the sutures was observed in any of these experiments performed in growing pigs.

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We recommend:

Peripheral Vascular Disease. By A. J. Barnett, M.D., Assistant Director. Alfred Hospital Clinical Research Unit, Melbourne; and J. R. E. Fraser, M.D., Sometime Registrar, Alfred Hospital Clinical Research Unit, Melbourne. 219 pages, with 39 plates (6 illustrations on 3 plates in color). New York, 1955. Cambridge University Press. *Price* $9.50. (A practical approach to the problem of peripheral vascular disease of the extremities based on clinical and experimental observations.)

Thoracic Surgical Management. By J. R. Belcher, M.S., F.R.C.S., and I. W. B. Grant, M.B., F.R.C.P Foreword by Sir Clement Price Thomas, K.C.V.O., F.R.C.S. Second edition, 216 pages, with 78 figures. Baltimore, 1955. Williams & Wilkins Co. *Price* $4.75.

Restoration of Vision in a Case of Progressive Exophthalmos

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THE following case seems sufficiently unusual and the result of treatment so dramatic as to deserve reporting:

The patient, a sixty-nine year old man, first came to the Jackson Clinic on June 18, 1925, at which time he had a severe case of exophthalmic goiter with a basal metabolic rate of +74 per cent; he weighed 160 pounds. Surgery was advised, and to prepare the patient thirty drops of Lugol's solution were given daily. On June 25th subtotal resection of the thyroid gland was performed, preserving about one-fourth of a normal-sized lobe on each side. The convalescence was uneventful; on August 15th the patient's basal metabolic rate was +11 per cent, the pulse rate had decreased from 122 to 72 and the patient had gained 18 pounds, bringing his weight to 178 pounds.

Sixteen years later, on August 22, 1941, the patient's basal metabolic rate was −12 per cent and the pulse rate 71. However, his weight was down to 157, or 3 pounds less than what it was at the time of his admission in 1925. Nine months later, on May 14, 1942, his weight had continued to decrease to 147 pounds and his basal metabolic rate had increased to +34 per cent. He showed definite signs of having recurrence of exophthalmic goiter with an increase in the size of the gland, progressive exophthalmos and other signs of toxicity. Lugol's solution (five drops daily) was given and one month later he had gained 10 pounds and was generally improved. On August 10th, his metabolic rate was +5 per cent; he had gained 15 pounds and his pulse rate was 76.

However, the thyroid gland gradually continued to enlarge, the exophthalmos became more marked, and on May 11, 1944, his basal metabolic rate was again elevated to +29 per cent although he had maintained his weight of 161 pounds. Because of the increased metabolic rate and the increased size of the thyroid gland, thyroidectomy was advised and performed with some difficulty due to scar tissue. The right lobe, isthmus and pyramidal lobes were considerably larger than at the time of the first operation nineteen years before; the left lobe appeared normal in size and was not resected. Two months following surgery the patient's basal metabolic rate was again a normal +3 per cent, with a normal pulse; there was a weight gain of 6 pounds.

At the time of the patient's return on August 22, 1946, he stated that he had been working very hard and had lost weight so that he then weighed 138 pounds. He was put on propylthiouracil, 25 mg. four times daily, and Lugol's solution, five drops daily. A month later he said he felt improved and was noticeably less nervous. Two years later he was still on propylthiouracil, with a normal rate of metabolism and weighing 182 pounds. During the next three years he occasionally received small doses of Lugol's solution, but no propylthiouracil. His condition remained satisfactory.

On December 18, 1950, he reported having recently recovered from a severe virus infection and that he had lost 24 pounds. Moderate exophthalmos was noted. A firm mass in the right lobe of the thyroid about 2 by 3 cm. and

another 3 by 6 cm. in the left lobe were noted; these masses appeared to be non-toxic nodular goiters. Auricular fibrillation was present and the basal metabolic rate was +13 per cent.

There was no change in the patient's condition during the next two years. He took digitalis occasionally, but no other medication. In 1953 he was in an automobile accident and sustained a mild concussion from a severe bump on the head. Almost immediately his eyes began to protrude, so that he consulted a local ophthalmologist. In turn he consulted other ophthalmologists because his vision was gradually failing. One of these men stated that in his opinion the failing vision was not the result of the automobile accident. This fact was important from the medicolegal aspect. The patient was examined on June 3, 1953, at which time the basal metabolic rate was +21 per cent, the pulse rate 67, his weight 166 pounds and the blood pressure 180/125; the blood pressure had been normal when last checked in 1950. The ophthalmologist stated that there was nothing he could do for the patient's failing vision and asked that the thyroid status be re-evaluated. Despite the elevation of the metabolic rate and the blood pressure, the pulse rate was normal and there appeared to be no recurrence of the hyperthyroidism; no medication was advised. The patient reported feeling fine with the exception of his failing eyesight.

On April 6, 1955, the patient returned to the Clinic, stating that he was unable to do any work but merely sit in a chair because he was nearly blind. He had to be led to a chair in my office. The right eye then showed progressing, grade 4 exophthalmos; the left eye, grade 3. He appeared rather listless and apathetic which I at first attributed to his near-blindness. His blood pressure registered 180/100; the multiple adenomas previously noted were present, but they were increased in size. His lack of alertness then suggested to me a possibility of a hypothyroid state. A metabolic test was ordered which gave the answer and the clue to his condition. The basal metabolic rate was −18 per cent.

After further consideration of the facts of the case I happened to recall that thirty-five years before I had operated upon a young woman who also had exophthalmic goiter. In her case, some months following thyroidectomy I was amazed to note that the exophthalmos which was scarcely noticeable at the time of operation was becoming progressively worse despite a basal metabolic rate of −17 per cent. About that time the *American Journal of the Medical Sciences* published a report by Richter and Zimmerman on eight similar cases. These surgeons were then advocating a radical type of thyroidectomy, as I recall, attempting to produce postoperative hypothyroidism in all their cases. I remember then giving this woman desiccated thyroid. Her metabolic rate was raised to normal and the exophthalmos gradually subsided.

The similarity of the conditions of this woman and our patient whose sight was nearly gone prompted me to start the patient on 1 gr. of Armour's desiccated thyroid for one week. At the end of this time the dosage was increased to 2 gr. per day. The effect was not only remarkable but also truly dramatic. Within two weeks he could see to get around the room alone. On May 10, 1955, one month after starting thyroid, his blood pressure had dropped to 146/90, the exophthalmos had receded to grade 1 on the right and to normal on the left, and he could see the distance of a block.

On July 13th, three months after the start of thyroid therapy, the basal metabolic rate had risen to −3 per cent, and the patient was able to read. He had much more pep and energy. He was able to recall events that had happened sixty years previously, whereas before treatment he could not recall events occurring in the previous twenty-four hours. His mind was no longer "in a fog." Prior to this treatment he had suffered from the cold weather. At his last visit his blood pressure was down to 135/70 and he could read fine print.

SUMMARY

In the course of nearly forty years, in studying many thousands of goiter cases, I thought I had seen every type of condition; however, the case presented herein is the most unusual. The patient first had a very severe exophthalmic goiter with exophthalmos. His condition returned to normal following thyroidectomy. Sixteen years later hyperthyroidism recurred and was again relieved by surgery. During the next ten years he suffered from a virus infection and had mild spells of hyperthyroidism controlled by Lugol's solution and propylthiouracil. Then following an automobile acci-

dent his metabolic rate increased and adenomatous nodules and progressing exophthalmos developed. His eyesight failed to the point of blindness and his condition became hypothyroid. He was placed on thyroid therapy and his exophthalmos disappeared, his eyesight returned, the adenomas all but disappeared, and his mental and physical status returned to normal.

In this one case can be found almost the entire story of thyroid disease—everything except, of course, thyroiditis and malignancy. If the patient lives long enough, perhaps even these may occur.

We recommend:

Transplantation of Tissue. Cartilage, Bone, Fascia, Tendon and Muscle. By Lyndon A. Peer, M.D., Clinical and Research Director, Rehabilitation Center for Plastic and Reconstructive Surgery, St. Barnabas Hospital, Newark, N. J. Volume 1, 421 pages, with 163 figures. Baltimore, 1955. Williams & Wilkins Co. *Price* $13.50. (This solid work on tissue grafting is readable and informative for the physician, surgeon and medical student.)

Suprapubic Prostatectomy. With Primary Closure of the Bladder by an Original Method. (Translated, completely revised.) By Univ.-Prof. Dr. Theodor Hryntschak. Authorized translation by Noble S. R. Maluf, M.S., M.D., PH.D. 187 pages, with 36 figures. Springfield, Ill. Charles C Thomas. *Price* $8.50.

Malignant Melanoma of the Gallbladder

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MALIGNANT melanoma can be found anywhere in the body but is most common on the lower extremities, then progressively less on the genitals, head and neck, trunk and upper extremities. It has a special predilection for the eye, the junction of the skin and mucous membrane at the site of body orifices, especially around the genitals and anus. It has been found occasionally in the meninges and rarely in the gastrointestinal tract.

Melanoma is found in Negroes in a ratio of 4.2 in Caucasians to 1 in Negroes, and usually at the site where there is less pigment.[1]

The tumor apparently is hormone-sensitive since it occurs in children but rarely metastasizes to lymph node or viscera before sexual maturation. Pregnancy stimulates the rate of progress of melanomas.[2]

Few people are without one or more nevi on their body surfaces; and since most melanomas probably originate in junctional nevi, it is remarkable that this is not a more frequently found lesion. Trauma in the form of chronic irritation has been seriously indicted in the etiology of melanomas. Areas that are subject to repeated injury of even the comparatively minor type are believed to be particularly vulnerable, i.e., where belts or collars may rub nevi, the sole of the foot, etc. Repeated shaving over facial nevi is frequently mentioned as a mechanism which converts a harmless nevus into a melanoma. It is difficult to assess the degree of guilt which should be attached to this possible etiologic agent. In attempting to evaluate this facet of the causation of melanoma, one encounters the same difficulties that have plagued other investigators who have studied the interplay between trauma and tumor formation.[3] On one hand the trauma recalled by the patient is at best a mere coincidence and therefore of no consequence. On the other hand is the opposite extreme where trauma, so minor as not to be noticed by the patient, may be seriously responsible. Whether malignant change has already occurred prior to the alleged injury is a possibility that should be kept in mind. Sequence and consequence must not be confused. Women who have never shaved in their lives are as apt to develop facial melanomas as are men who have shaved daily over a long period of years. It is impossible to foretell from the type and degree of trauma the likelihood of subsequent malignant change.[4]

Allen and Spitz[5] believed that no amount of trauma to the intradermal nevus will convert it to a malignant lesion.

Raven[6] comments: "Clinical experience with this disease teaches that a long time interval may elapse between the excision of the primary tumor and the appearance of metastasis. The literature contains the case records of patients in whom metastasis developed up to 32 years after excision of the primary tumor. It is pointed out that this property to develop delayed metastases is not peculiar to malignant melanoma."

Catlin[7] says, "Melanomas are rare and unpredictable tumors." Metastases to the gastrointestinal tract are even more rare, and only six cases have been reported in the gallbladder. To these we wish to add a seventh case in this unusual site.

Wieting and Hamdi[8] in 1907 described primary melanocarcinoma of the gallbladder with metastasis to the omentum, pelvic connective tissue and vertebrae. In 1931 Rosenthal[9] presented a primary malignant melanoma of the gallbladder with metastasis to the lungs, brain, jejunum and kidney. Pautler and Gallavan[10] in 1951 reported melanomatous tumors found simultaneously at autopsy in gallbladder and

brain, and concluded that the primary source was in the meninges. Later in 1951 Madonick and Savitsky,[11] in discussing the occurrence of hemorrhage in cerebral melanomas, described a case which showed a collection of melanin pigment in the gallbladder at surgery. Cerebral symptoms subsequently developed and melanin was found in the spinal fluid. In 1955 Thayer, Williams and Rowe[18] reported a case of malignant melanoma involving the gallbladder, meninges, adrenal and lungs. In 1953 Ludin[12] described a case of generalized metastases from malignant melanoma with involvement of the gallbladder as well as stomach, duodenum and small intestines.

CASE REPORT

E. I., a sixty-five year old woman, was admitted on March 3, 1950, because of a mole 1½ cm. in diameter on the right side of the neck. The mole had been present for many years but had become ulcerated and had been bleeding for approximately two months. There were no palpable glands. The mole was removed on March 6th and the pathologist reported it to be a malignant melanoma.

There were no further findings until August, 1954, when a small lump developed under the skin just below the right elbow. This was excised and proved to be melanocarcinoma metastatic to skin.

In December, 1954, a tender, globular mass developed in the right upper quadrant of the abdomen. There was some pain and indigestion but no colic. The patient refused hospitalization at this time but did consent to the taking of a cholecystogram which showed a non-functioning gallbladder; no stones were seen. A barium enema was given because of rapidly developing constipation not previously present. This examination showed no abnormality except for an indentation on the superior margin of the hepatic flexure, due apparently to an enlarged gallbladder.

The patient finally consented to operation and on February 5, 1955, exploratory surgery was done. Despite the fact that this was only two months after the onset of symptoms, the gallbladder was found to be distended, thick-walled and purplish in color. It was acutely inflamed to the point where it was impossible to tie a metal cannula or polyethylene tube into the cystic duct for an operative cholangiogram because the edema of the tissues prevented the placing of a tie snugly enough to avoid reflux of the injected contrast medium.

The liver showed congestion and there was a dark spot 2 cm. in diameter on the right lobe just above the gallbladder bed.

Microscopic examination showed no evidence of tumor in the liver. There were, however, focal areas of necrosis with diffuse deglycogenization of the parenchyma. Microscopic examination of the gallbladder revealed diffuse areas of organizing hemorrhage and compact masses of infiltrating tumor cells with frequent melanin-like pigmentation. The diagnosis was: (1) subacute cholecystitis; (2) malignant melanoma, metastatic to gallbladder; (3) focal necrosis of the liver.

The patient made an uneventful recovery, and as late as June 21, 1955, she maintained her weight and had no symptoms or abnormal findings. However, during July, 1955, signs of lung metastasis rapidly developed and she died in two weeks.

SUMMARY

A case is presented of a sixty-five year old woman who underwent removal of a primary malignant melanoma of the neck in March, 1950. A metastatic skin nodule showing melanocarcinoma was removed from the right forearm in August, 1954, and a gallbladder showing metastasis of malignant melanoma in February, 1955. Four months later there was no clinical evidence of recurrence and the patient was symptom-free. However, only two weeks after that signs of lung metastasis developed, from which the patient suddenly died.

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Surgical Forum. Proceedings of the Forum Sessions, 40th Clinical Congress of the American College of Surgeons (November, 1954). 851 pages, illustrated. Philadelphia. W. B. Saunders Co. *Price* $10.00. (Excellent.)

Incarcerated Congenital Diaphragmatic Hernia

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IT has been truly said that one may profit more by failure than by success. In surgery we are more boastful of our accomplishments and try to hide our poor results, yet both are important if the failure prevents a similar error, or in some way teaches us a lesson. I should like to report a case in which operation was successful. However, the end result must be labelled a failure because the patient died.

CASE REPORT

On September 9, 1954, a healthy twenty-nine year old housewife (gravida II, para I) gave birth to a 9 pound, 2 ounce baby boy, who was normal by all external appearances except for hypospadias. The baby cried immediately and spontaneously after delivery. However, respirations were rapid and the infant was slightly cyanotic. Because of the cyanosis he was placed in an incubator: constant administration of oxygen was necessary. Thorough physical examination revealed a displacement of the heart into the right chest with an absence of breath sounds in the left chest. "Rumbles" were heard in the left thorax and an x-ray was taken. (Fig. 1.)

The x-ray revealed that the entire left hemithorax was filled with coils of intestine. No lung tissue was evident in the left chest. The heart and mediastinum were shifted into the right chest. The diagnosis was incarcerated left diaphragmatic hernia due to a congenital defect.

A surgical consultation was obtained and it was agreed that surgery was indicated. It was realized that although the small intestine was incarcerated in the thorax, the bowel was not strangulated. The problem confronting us was that the infant was constantly cyanotic and became more deeply cyanotic when he was fed. His formula was retained except for a few occasions when he vomited part of his feeding. This was overcome when the infant was placed in a high Fowler's position.

The parents were informed of the seriousness of the situation and that surgery was necessary. After two days of procrastination the parents consented to surgery.

An abdominal operation was planned for this infant in order to ascertain the presence of any additional anomalies which might be corrected surgically. The thoracic disorder was shown by x-ray, and it was believed that the diaphragmatic defect could be repaired abdominally. This plan was carried out with great difficulty because of the persistent cyanosis, which continued even after the anesthetist had passed an intratracheal tube. However, when the abdomen was entered the incarcerated viable small intestine was liberated and returned to the peritoneal cavity. Only one-third of the left diaphragm was present due to a congenital absence of tissue in the central area. There was no other intra-abdominal anomaly or disorder present. As far as could be visualized or palpated, the left lung was collapsed in the apex of the left thorax. The heart was completely displaced into the right thorax with partial collapse of the right lung. At this point the anesthetist reported that the infant was in distress; the heart fibrillated. Intravenous novocain® was administered. The surgeon displaced the spleen into the absent diaphragmatic space and forced it snugly so that it was fixed therein. It was foolish to believe this would stay *in situ*. However, at the time the major consideration was to keep the patient alive and perhaps operate again at a later date. The abdomen was closed and the infant was returned to his incubator. A postoperative x-ray taken on September 17, 1954 (several days after surgery), demonstrated "the heart and mediastinum to be grossly unchanged compared to the previous

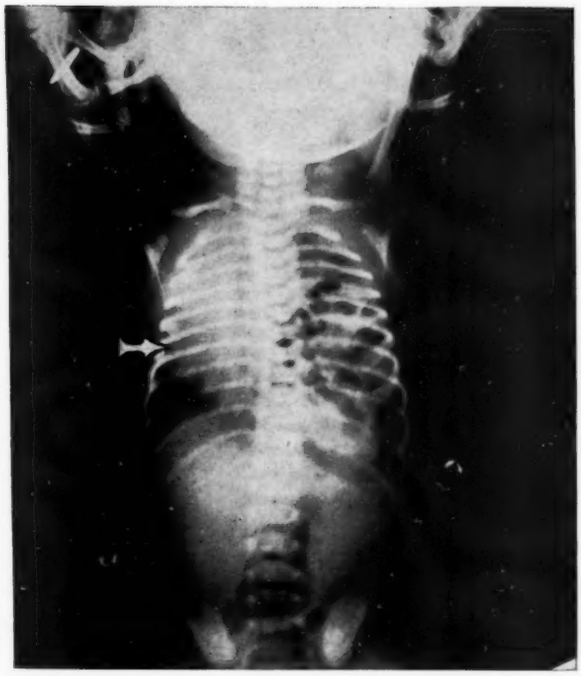

FIG. 1. X-ray taken soon after birth showing coils of small intestine filling the entire left thorax. No lung tissue is visible in the left chest. The heart is displaced into the right chest. The roentgenologist's diagnosis is that of an incarcerated congenital diaphragmatic hernia. The arrow marks the cardiac displacement. Note that there is non-visualization of the left diaphragm due to its congenital absence and the presence of the distended bowel.

FIG. 2. X-ray taken after the first operation. This film reveals the heart and mediastinum to be unchanged as compared to the previous x-ray examination, i.e., displacement into the right hemithorax. The left lung is aerated and has expanded to the fourth rib. A solid intra-abdominal organ (spleen) lies between the aerated left lung and the coils of intestine which are in the left upper quadrant of the abdomen. The top arrow marks the expanded lung tissue. The center arrow indicates the solid organ between the lung and the intestine. The lowest arrow points to the small bowel identified by the gas in the lumen of the intestine.

examination (displaced into the right hemithorax). The left lung is aerated and has expanded to the left fourth rib posteriorly. A solid intra-abdominal organ (spleen) lies between the aerated left lung and the coils of intestine which lie in the left upper quadrant of the abdomen." (Fig. 2.)

This situation gave us a sense of false hope and security. The infant was no longer deeply cyanotic even when he was taking his formula. He no longer needed continuous oxygen. The infant was removed from the incubator for long intervals of time. The nurse would feed him outside the incubator on many occasions, without signs of distress.

On September 27, 1954, the infant suddenly became deeply cyanotic. Our fear was that the small bowel had again herniated into the thorax and that the spleen had fallen, and no longer acted as a "plug." An x-ray was taken confirming the suspicion. Multiple coils of small bowel had re-entered the thorax. (Fig. 3.)

The father and mother were informed of this sudden change for the worse. They felt that if the boy were going to die, they would want him to die at home, this despite the patient's need for oxygen which was emphasized.

The parents were allowed to have one of the hospital incubators, in which the infant was taken home. On December 15, 1954, the parents were alarmed when the infant became deeply cyanotic during the course of feeding. (The baby had been home since September.) At the suggestion of the family doctor, the infant was returned to the hospital and the surgical department was again consulted.

Another x-ray was taken which was similar in appearance to that described previously showing an incarcerated diaphragmatic hernia. (Fig. 3.) The parents were again advised as to the seriousness of the situation. The surgical department agreed to reoperate. There was no enthusiasm for this operation as the infant was cyanotic even under constant oxygen.

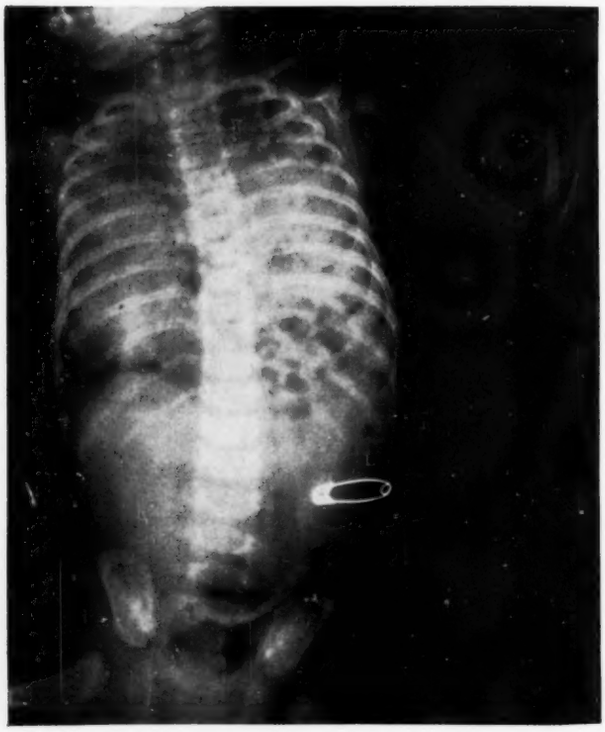

FIG. 3. X-ray taken sixteen days following surgery. Multiple coils of small intestine have re-entered the left hemithorax, indicating that the spleen has slipped back into the abdomen and that the herniation has recurred.

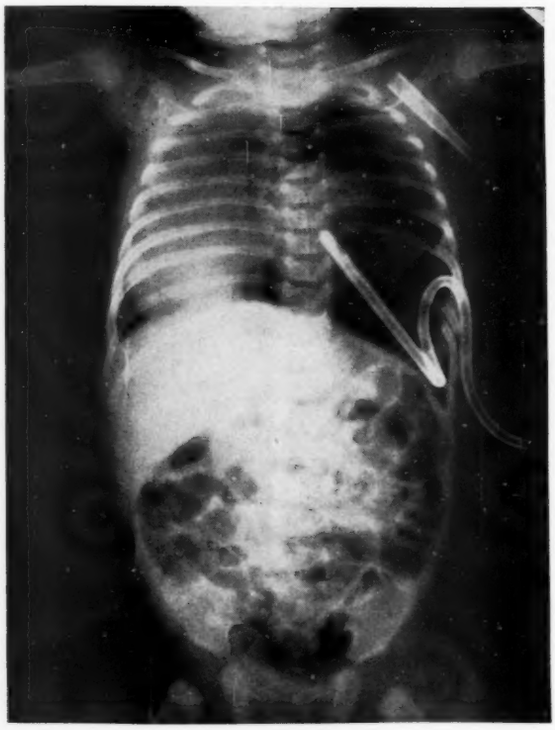

FIG. 4. Postoperative x-ray (second operation). This shows the gastrointestinal tract to be below the diaphragm. The diaphragm itself has a normal appearance. Pneumothorax with a drainage tube *in situ* is noted. The left lung is collapsed 70 per cent. The heart and right lung are unchanged as compared to previous x-rays.

Prior to operation all conceivable consultations were obtained. All agreed that the prognosis was grave and that surgical intervention was imperative even in the face of an operative mortality.

Surgery was performed through the thorax on December 18, 1954. The left chest was filled with small bowel which was redeposited into the peritoneal cavity. The missing diaphragm was again visualized. It could not be approximated because of excessive tension on the sutures. The diaphragmatic leaves were divided in their anteroposterior directions forming sliding grafts. This allowed an approximation of the diaphragm with black silk and thus the hernial hiatus was closed.

During the course of surgery, cardiac arrest occurred for ten minutes. Manual resuscitation returned the heart beat. Fibrillation was controlled via intracardiac novocain solution. A catheter was placed in the left chest and double-bottle, water-sealed suction applied. The left lung did not expand completely and the heart and mediastinum remained in the right chest. The child was placed in the incubator. In spite of surgery, intravenous fluids, oxygen and excellent nursing care, the baby died on the first postoperative day. (Fig. 4.)

The autopsy report is summarized herewith (only the pertinent positive findings are recorded). There was a moderate amount of postmortem lividity noted in the dependent portions of the body. This lividity was most marked in the cervical region and the head. When the abdomen was opened there was only about 1 cc. of hemorrhagic fluid in the peritoneal cavity. There were several black silk sutures in the left leaflet of the diaphragm which closed the diaphragm completely. The stomach was adherent to the liver. The small intestines were collapsed and the colon slightly dilated in relative comparison. The colonic distention was due to feces and gas. All of the intestines were in the peritoneal cavity. The mesentery of the small bowel was abnormally long. The cecum was freely mobile and was found in the umbilical region. There were a few intra-abdominal adhesions among

the loops of small bowel. The spleen was in its usual location and showed only a slight congestion when sectioned. The other abdominal and retroperitoneal organs were normal.

The thoracic organs presented the following pathology. The heart was a classic picture of dextrocardia, but otherwise was normal. In the left pleural cavity about 5 cc. of hemorrhagic fluid were found. There was no fluid in the right pleural cavity. The heart was in the right chest with the thymus gland overlying the superior aspect of the heart. The right lung was retracted posteriorly. The left chest was empty except for the fluid previously mentioned and the left lung which was found in the upper posterior portion of the pleural cavity with the apex rotated inwardly. The trachea and bronchi contained grayish brown, mucoid material. The right middle lobe was emphysematous. The upper and lower lobes showed patchy areas of congestion. The left lung was heavier than normal lung tissue should be. The upper lobe was tan in color with visible decreased aeration. The left lower lobe was similar in type but demonstrated areas of congestion. Sections from all five lobes floated when placed in water. Microscopic study of the lung tissue (right middle lobe) revealed marked emphysema. The remaining four lobes showed partial to complete atelectasis in the major portions of the lung parencyma. When this was not revealed, the remaining lung tissue consisted of normal or slightly emphysematous alveoli. Histologic studies of the other organs demonstrated nothing significant. The cause of death was attributed to pulmonary insufficiency due to congenital abnormalities of the lung.

COMMENTS

The complete life history of a three month old baby boy is presented for critical review. This infant was born with a congenital absence of almost two-thirds of the left diaphragm, which predisposed to herniation and incarceration of the entire small bowel in the left thoracic cavity. When this occurred the child was cyanotic and required continuous oxygen. At the time of birth the left lung was completely collapsed, the heart was displaced into the right thorax and the right lung was only partially aerated, primarily because of congenital atelectasis and secondarily because of the cardiac displacement and compression.

After undergoing two surgical procedures the infant died. The details of the operations and the autopsy findings have been presented.

The problem to be solved involved the absence of adequate diaphragmatic tissue and how to manage it. Our efforts of using the spleen as a tampon was not expected to "work," but it was so used because of the urgent necessity of ending the operation in order to keep the infant alive. At the second operation the diaphragmatic defect was closed, but the patient died. Apparently the lung tissue was not adequately expanded to maintain life.

It has been suggested by European authors that large diaphragmatic defects could be repaired with preserved fascial grafts.[1] This suggestion is worthy of note and perhaps a graft of this type would have expedited the surgical procedure.

Be that as it may, the belief of almost everyone concerned was that the situation was hopeless from the beginning and that surgery merely delayed the inevitable outcome. Perhaps, in retrospect, it would have been wiser to have performed the first procedure via the thorax and explore the abdomen through the thoracic incision since the diaphragm was an avenue of approach due to the congenital disorder. Then, with a fascial graft, the absent diaphragmatic tissue could have been replaced.

Surgically speaking, this would be sound, but the problem of cardiac displacement and the congenital partial to complete atelectasis of four pulmonary lobes remained. Perhaps we should evaluate our limitations and realize that we can only take the ordinary means of preserving life and that extraordinary means are usually futile.

SUMMARY

1. The life history of a three month old baby boy with a congenital diaphragmatic hernia is presented.

2. The salient features of the problem were incarceration of the small bowel, absence of diaphragmatic tissue, cardiac displacement and pulmonary collapse of four lobes.

3. After two attempts at surgical repair of the hernia, the baby died.

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Simultaneous Neurofibrosarcoma of the Breast and Back in von Recklinghausen's Disease

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THE tendency for a small percentage of neurofibromas to undergo sarcomatous alterations is recognized. In 1952, French[1] reported eighty-eight cases from the literature and added one case of his own. The following case is of interest because it represents the development of a neurofibrosarcoma of the breast simultaneously with the recurrence of an incompletely excised tumor from the back.

CASE REPORT

The patient, a fifty-five year old Negro woman, was referred to the University of Arkansas Hospital for evaluation of a rapidly growing tumor in the right breast and a recurrent tumor on the back. She was mentally defective and could barely talk. Multiple skin tumors over the trunk and limbs, typical of von Recklinghausen's disease, had been present all her adult life. There was no familial history of neurofibromatosis.

Approximately ten months previous to this admission, her physician had excised what appeared to be a neurofibroma on her back. The patient had requested surgery because of mild tenderness. Grossly the lesion was described as pedunculated and attached to the skin. Unfortunately, no pathologic report is available. Three months before this admission, the tumor recurred and began to grow rapidly, and at the same time, she first noticed a mass in her right breast. Both tumors had progressively increased in size. There had been no weight loss and no systemic complaints.

Examination revealed a multiloculated, raised, cystic mass, measuring 8 by 10 cm., overlying the tenth to twelfth ribs in the right paravertebral area. The lesion appeared to involve the skin and the subcutaneous tissue. The skin was reddened, but not ulcerated. The margins were irregular, but appeared to be definite. The mass was not fixed to the underlying deep fascia and was not tender. A second similar fluctuant tumor, 8 by 20 cm. in size, was found in the upper outer quadrant of the right breast. This mass extended upward into the anterior axillary fold and was also raised, reddened and non-tender, with irregular distinct outlines. The lesion was attached to the overlying skin to give an orange-peel appearance, but there was no fixation to the underlying pectoral musculature. The nipple was not retracted and there was no evidence of discharge. No axillary, parasternal or supraclavicular lymph nodes were palpable. In addition, there were multiple cutaneous neurofibromas over the trunk and extremities that were typical of the neurofibromas in von Recklinghausen's disease. No areas of increased or altered pigmentation were recognized. The chest film was non-contributory. A diagnosis of neurifobrosarcoma was made. (Fig. 1.)

At surgery, both lesions were removed *en bloc* with a 2 cm. margin of normal tissue and the underlying fascia. The lesion in the right breast was removed by radical right mastectomy which included the right axillary lymphatics and areolar tissue. The skin defects on the anterior and posterior chest wall were covered with split-thickness autogenous skin grafts. No suspicious lymph nodes were found during the resections.

On gross examination, the specimen from the back measured 12 by 14 by 8 cm. The upper surface was covered by brown skin and the

undersurface by fascia. On section, the tumor was soft, grey and nodular, with areas of hemorrhagic necrosis which coalesced to form three blood-filled cystic spaces 1 to 2.5 cm. in diameter. The tumor edge was distinct and the excised margins appeared to be adequate. The lesion extended down to, but did not invade, the lumbodorsal fascia. No satellite nodules were present.

The breast lesion was attached to an elliptic piece of skin that included the nipple and measured 20 by 12 cm. The axillary contents were attached. The section showed a greyish lobular structure, similar to the back lesion, with multiple areas of hemorrhagic necrosis that had coalesced to form two large cystic cavities filled with brownish fluid. The margins of the tumor appeared to be distinct and the line of excision adequate. There was no involvement of the pectoral muscles, nipple or subareolar tissue.

Microscopically, the tumors were highly cellular with large cyst-like areas of hemorrhage, and occasional foci of hyalinization. At the margins, the tumor cells invaded the adjacent subcutaneous tissues in finger-like strands, and in some areas extended almost into skeletal muscle. The upper corium and epidermis were not invaded. The tumor was arranged in poorly formed fascicles and a rare, poorly formed, Verocay nodule was seen. The tumor cells were round to oval, with poorly defined borders and eosinophilic cytoplasm. The nuclei were oval, with slight irregularities in contour, a vesicular chromatin network, and one to three small nucleoli. One to four mitoses were seen per high power field.

FIG. 1. The recurrent neurofibrosarcoma on the back.

COMMENTS

The incidence of sarcomatous changes in preexisting neurofibromas is usually stated as 13 to 16 per cent.[2,3] This figure may be too high as the unusual cases are more likely to come to the attention of the physician. Sarcomatous changes do not appear to be associated with race.[2] The highest incidence is in the third and fifth decades of life,[3] but these changes may occur at any age. Kredel reports a spindle-cell sarcoma of the median and ulnar nerves in a month old infant.[5] The number of cutaneous neurofibromas does not appear to influence the occurrence of sarcomatous change.[3]

The older literature contains abundant references to sarcomatous alterations in benign neurofibromas following surgery.[2,6] This concept has been questioned in recent years and several large series are now reported with routine diagnostic biopsies of neurofibromas without an increased incidence of sarcomatous development.[5] As in this case, many lesions thought to be benign at the time of original surgery were probably sarcomatous.

The significance of any unusual breast lesion is its differentiation from carcinoma of the breast. The absence of deep fixation, nipple retraction and metastatic lymph nodes in this case are more suggestive of a sarcomatous lesion. The lesion with which this tumor would most likely be confused clinically would be cystosarcoma phylloides.[7,8] Both tumors might be partly necrotic, fluctuant and multiloculated, and without obvious metastases; both might be associated with exacerbations of growth without attachment to underlying fascia or muscle, and both may have distinctly outlined margins. Cystosarcoma phylloides is usually associated with a long-standing fibroadenoma of the breast. To our knowledge, our patient had no previous breast masses. The presence of multiple neurofibromatosis with a history of a recurrent sarcomatous lesion on

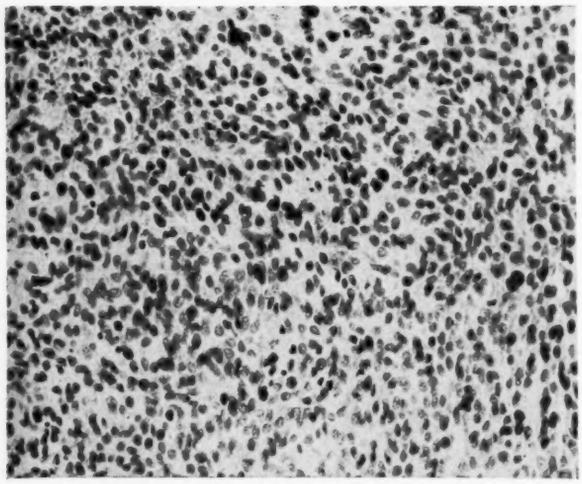

FIG. 2. Photomicrograph of the breast lesion showing the oval nuclei with poorly formed fascicles and mitoses. What appear to be poorly formed Verocay's nodules are present.

the posterior chest helped to make the preoperative diagnosis in this case. We could find no previously reported cases of neurofibrosarcoma of the breast which developed simultaneously with the initial appearance or the recurrence of another neurofibrosarcoma elsewhere on the body. Jackson reported a neurofibrosarcoma of the breast associated with an undiagnosed osteolytic lesion of the sixth thoracic vertebra which was thought to be a neurofibroma.[9]

According to Stout,[10] two types of lesion may exist in what is clinically described as multiple neurofibromatosis or von Recklinghausen's disease. Both are derived from the sheath of Schwann, in part, if not completely. The neurilemmoma is an encapsulated tumor of the peripheral cutaneous nerves and is composed of whorls of spindle cells. The neoplasm is always benign and may be removed surgically with safety.[11] A second type of neural sheath tumor may involve nerve tissue anywhere in the body. This tumor is non-encapsulated and lacks the orderly appearance of neurilemmoma. Some degree of fibrous tissue proliferation is usually evident. This is the true neurofibroma that may undergo sarcomatous alterations. The pedunculated skin tumors so characteristic of the disease tend to be neurilemmomas, for the most part. Sarcomatous changes usually are deep to the skin surface. This would certainly suggest that the pedunculated cutaneous neurofibromas are usually benign, and neurofibrosarcomas arise for the most part from the plexiform neuromas of the cutaneous and peripheral nerves.[12] (Fig. 2.)

Speed has emphasized that a neurofibrosarcoma may expand very slowly at first, with a sudden spurt of growth if the capsule is broken or incised by the surgeon.[13] Slow growth and long duration of a neurofibrosarcoma do not necessarily indicate a low grade of malignancy. Clinical evidence of malignancy may precede recognizable morphologic alterations, as shown in Trueblood's case in which a diagnosis of malignancy could be made only from the fourth biopsy specimen of a clinically malignant lesion.[14] Most workers are agreed that the microscopic determination of sarcomatous change in a neurofibroma is difficult.[15] Usually the whorled spindle pattern is preserved to some degree. In more anaplastic forms, as in this case, atypical oval nuclei are present with varying degrees of pleomorphism and mitotic activity. Metastasis is often delayed and occurred in only 22 per cent of the cases in one series. The usual route of metastasis is by the blood stream to the lungs. Lymphatic spread to the inguinal nodes from a neurogenic tumor of the thigh has been reported.[16]

Irradiation has proved ineffectual as therapy, and today only surgical extirpation is an accepted method of treatment. Since metastasis is usually late, early and adequate surgical removal should offer a more favorable outlook. Charache says the initial surgery is inadequate in 75 per cent of the cases.[6] The initial attack must be undertaken with caution. A recurrent lesion is nearly always worse than the original, and metastases appear to be accelerated. Wide local excision is the procedure most commonly employed and appears to be adequate when properly done. Amputation and ultraradical procedures would theoretically offer a greater chance of removing all the tumor, but they are usually reserved for cases with recurrence.[15] Most surgeons believe that the key to future surgical improvement lies in the increased awareness of the general medical profession to the occurrence of these tumors and the danger of delayed and inadequate treatment. Sarcomatous alterations in neurofibromatosis usually give little warning. Sometimes a patient may be able to detect an early increase in size, and invasion into an adjacent cutaneous nerve

may cause pain or tenderness. Although cases have been reported of survivals up to fifteen years,[17] five-year survivals with or without surgery are still infrequent. Preston reports three five-year survivals in eight resections.[3] Two of these have metastatic disease. The prognosis is believed to be even worse with multiple neurofibrosarcomas.[15]

SUMMARY

Early sarcomatous changes in neurofibroma are difficult to recognize either clinically or microscopically. The surgeon must view any neurofibroma that he is requested to remove, save for purely cosmetic or diagnostic reasons, with a high index of suspicion. Recurrence following surgical removal is very high and inadequate removal may accelerate the course of the disease. Metastasis and sarcomatous alterations in other neurofibromas are associated with recurrence.

A case of neurofibrosarcoma of the breast associated with a recurrent neurofibrosarcoma of the back is presented, and the significance of the breast lesion in differential diagnosis is discussed.

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Appendectomy Performed during the First Stage of Labor

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THE occurrence of acute appendicitis in pregnancy is relatively common, especially during the first six months of gestation. However, the diagnosis and confirmation of acute appendicitis beginning and operated upon during the course of labor is relatively infrequent. Meiling[1] collected nineteen cases of appendicitis during labor and added two cases of his own. The University Hospitals of Cleveland reported acute appendicitis complicating pregnancy, labor or puerperium in the ratio of 1:1,910. The report of a case in which appendicitis developed, requiring surgery during labor, therefore seems indicated.

CASE REPORT

V. R., a twenty-one year old primipara, whose estimated date of confinement was September 2, 1952, was admitted to The Lankenau Hospital at 10 P.M. on August 28, 1952. Her prenatal course was entirely normal and labor had begun at approximately 5 P.M. on the same date. The first five hours of labor were characterized by short ineffectual contractions, much anxiety and frequent episodes of nausea and vomiting.

Examination on admission was entirely normal except for beginning normal early labor. Contractions occurred every four to five minutes and lasted thirty seconds. The patient's blood pressure was 124/84, pulse 90 and the fetal heart rate 140 per minute. Rectal examination revealed the cervix to be 3 cm. dilated, 75 per cent effaced with the vertex at station O. The membranes were intact; the vertex was right occiput transverse.

The patient was given a routine enema and 1½ gr. seconal® by rectum because she was continually nauseated. It was thought that her nausea was of psychic origin.

Five hours after admission the patient began to complain of continuous pain in the right lower quadrant of the abdomen; this pain did not disappear between contractions. Examination at this time revealed marked tenderness on the right side of the uterus about 5 cm. above the right superior-anterior iliac spine. Although the patient had no further nausea and vomiting at this time, her fever was 100°F. Contractions still occurred every four to five minutes with a duration of approximately forty-five seconds. The cervix by rectal examination was now 5 cm. dilated and 90 per cent effaced. The membranes were intact and there was no vaginal bleeding.

Differential diagnosis included abruptio placentae, twisted ovarian cyst, appendicitis and right pyelitis. Laboratory examination at this time was of little value. Urinalysis gave essentially negative results, with a few pus cells per high power field and leukocytosis of 12,500, which is not unusual during labor.

Three hours later surgical consultation was obtained. In view of the well developed signs of tenderness and rigidity in the right lower quadrant of the abdomen and in the absence of a mass in this area, a diagnosis of acute appendicitis was made.

Under spinal anesthesia and through a McBurney incision the peritoneal cavity was entered (E. W. S.). Cloudy fluid was released. An acutely inflamed gangrenous appendix covered with fibrinous exudate was found lying retrocecally. There was leakage at the base. Routine appendectomy was performed and a cigarette drain was placed in the bed from which the appendix was removed.

The patient withstood the operation well. She was treated with gastroduodenal suction,

intravenous fluids and antibiotics consisting of penicillin, streptomycin and terramycin.®

Five hours later, as the spinal anesthesia diminished, the patient again went back into active labor. The remaining first stage of labor was approximately seven hours and was managed with the patient under demerol® and scopolamine.® As soon as the cervix was completely dilated, the patient was delivered of an 8 pound, 4 ounce male infant under spinal anesthesia by mid-forceps with an episiotomy. Both mother and infant withstood both procedures without any untoward reaction.

The postoperative and postpartum course was completely uneventful. The drain was removed on the eighth postoperative day. The appendectomy incision healed well and rapidly. The patient was discharged from the hospital on the tenth day after operation and delivery.

Follow-up eight months later elicited no late sequelae from the operation or pregnancy.

COMMENT

Various plans have been proposed for the management of patients with acute appendicitis during labor. Some authors[2] advocate immediate cesarean section followed with appendectomy in the presence of peritonitis. Others advise termination of pregnancy by manual dilatation followed with forceps delivery or cesarean section followed with surgery of the appendix.[3] Still other writers believe that acute appendicitis presents a surgical emergency, and that appendectomy should be performed first, allowing delivery to proceed to normal termination.[4,5]

The latter plan of management was that selected by the authors, and the uncomplicated postoperative and postpartum course seems to justify this manner of treatment in our case.

SUMMARY

A case is recorded in which signs and symptoms of acute appendicitis developed after the onset of labor in a primipara. Immediate appendectomy was performed, followed by normal termination of labor. The patient made an uneventful recovery.

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Ulcer of the Greater Gastric Curvature

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FEW experiences approach the horror felt by a patient with a sudden gastric hemorrhage. When this occurs and the patient has a history of dyspepsia, either gastric carcinoma or an ulcer is suspected. It is the roentgenologist who then helps with the diagnosis. Should a filling defect be observed on the lesser curvature of the stomach or in the duodenum, the lesion is usually called benign. The possibility of malignancy is mentioned occasionally if the ulcer is on the lesser curvature. However, should this defect be on the greater curvature, the diagnosis is usually carcinoma or carcinomatous gastric ulcer. Benign gastric ulcer on the greater curvature is a very rare lesion.

FIG. 1. A large negative filling defect along the greater curvature of the body of the stomach is present. Within it is a large crater measuring 3.5 cm.

Lahey[1] stated that he had never seen an ulcer on the greater curvature which was benign. Brown and Intriere,[2] recently reported two cases of this condition, making a total of forty-two cases reported and histologically proved.

This report will add an additional case to the literature; however, the chief purpose is to emphasize that even repeated x-ray reports should be accepted with some doubt when dealing with gastric ulcer. If there has been perforation, the gross findings at operation further suggest the diagnosis of malignancy. In such cases one may undertake what appears to be a hopeless resection and then be rewarded with the discovery that the lesion was benign and only masqueraded as a malignant condition. One must always keep in mind, particularly in dealing with an ulcer on the greater curvature which has perforated into the pancreas, that even though the condition is extremely rare, benign ulcers of the greater curvature of the stomach do exist. Inflammatory reaction resulting from such an ulcer will resemble a widespread malignancy. When the stomach becomes fixed to the pancreas, the perforated ulcer helps to spread irritating secretions over the pancreas and the inflammation resulting in that organ and in the mesocolon will simulate malignant invasion to sight and to touch.

It is only with a microscope that one can differentiate between a malignant and benign ulcer. Many pathologists who have looked at masses of resected tissues and have stated emphatically that they felt and looked like carcinoma, were thoroughly surprised when the sections showed inflammatory tissue. In our own experience we recall lesions that appeared

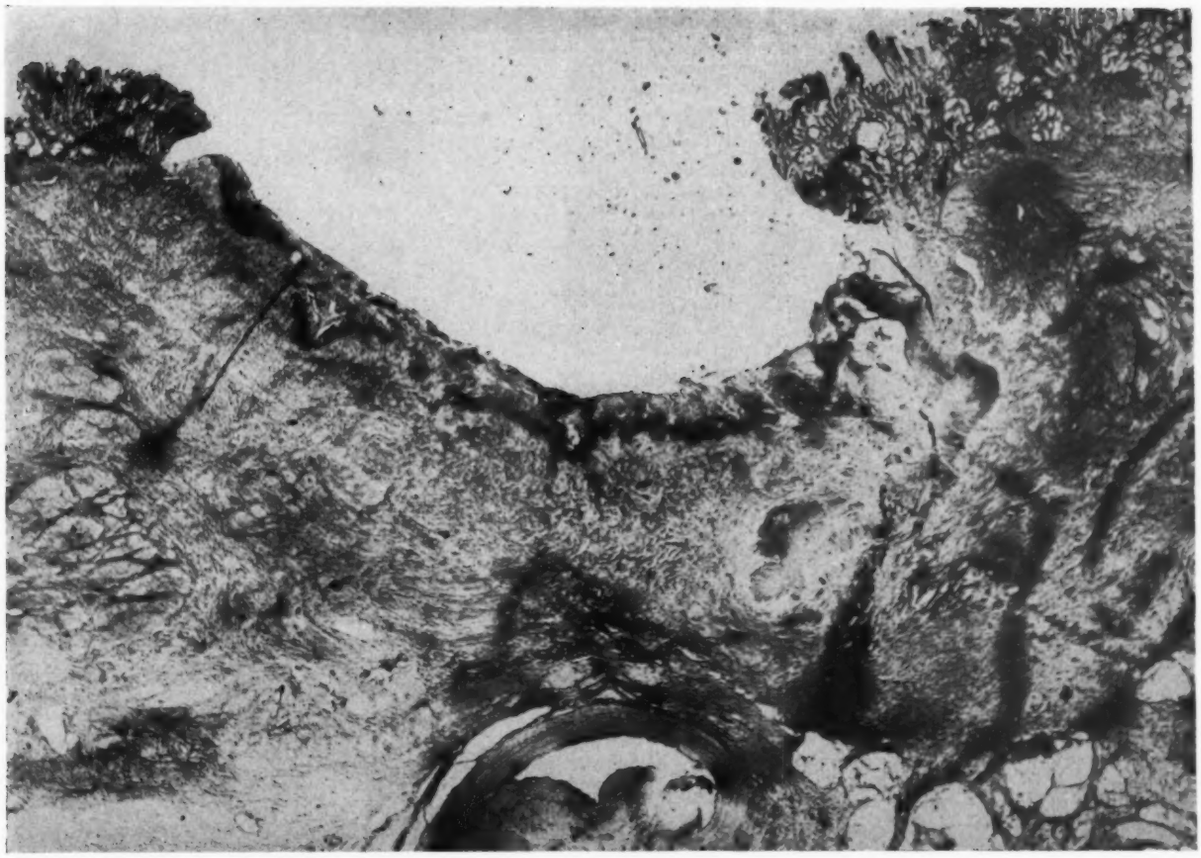

FIG. 2. Ulceration of the stomach with necrosis of the mucosa (low power field).

to be hopeless, far advanced malignancies of the large bowel, which on pathologic examination proved to be inflammatory granulomas.

When the surgeon operates for what is diagnosed as malignant ulcer of the stomach and finds a hardened stomach, thickened pancreas, indurated mesocolon and enlarged lymph glands, with the entire mass firmly adherent to adjacent structures, it is a great temptation to close the incision without an attempt at resection. By saying, "What's the use, this is too fixed and is not resectable," one satisfies his conscience. If the patient has been admitted with an acute hemorrhage, closing the incision without resection may leave the patient with little chance for survival should another hemorrhage occur. This is especially so because of the reluctance to give blood and unnecessarily prolong the life of a patient who apparently is dying from a malignant lesion. One wonders how many patients with benign perforating gastric ulcers on the greater curvature have lost their chance for cure because of these conditions.

It is also possible that a patient, who at operation had been given up as hopeless, could without resection recover from the ulcerated condition and continue to live and even show signs of improvement; even after the family had been told to expect the worst. Should a patient of this type, sentenced as hopeless, be taken to an irregular practitioner or cancer charlatan and then recover spontaneously, a great many intelligent people might find it difficult not to believe in the curing powers of these charlatans.

The following case is the forty-third instance of histologically proved benign ulcer on the greater curvature of the stomach. The report will also bring out some of the points mentioned in the aforementioned discussion.

CASE REPORT

The patient, a fifty-two year old white man weighing 197 pounds and 6 feet, 2 inches tall, was admitted to the hospital on August 8, 1954, after he had had a severe gastric hemorrhage. His hemoglobin was 8 gm. Past history was

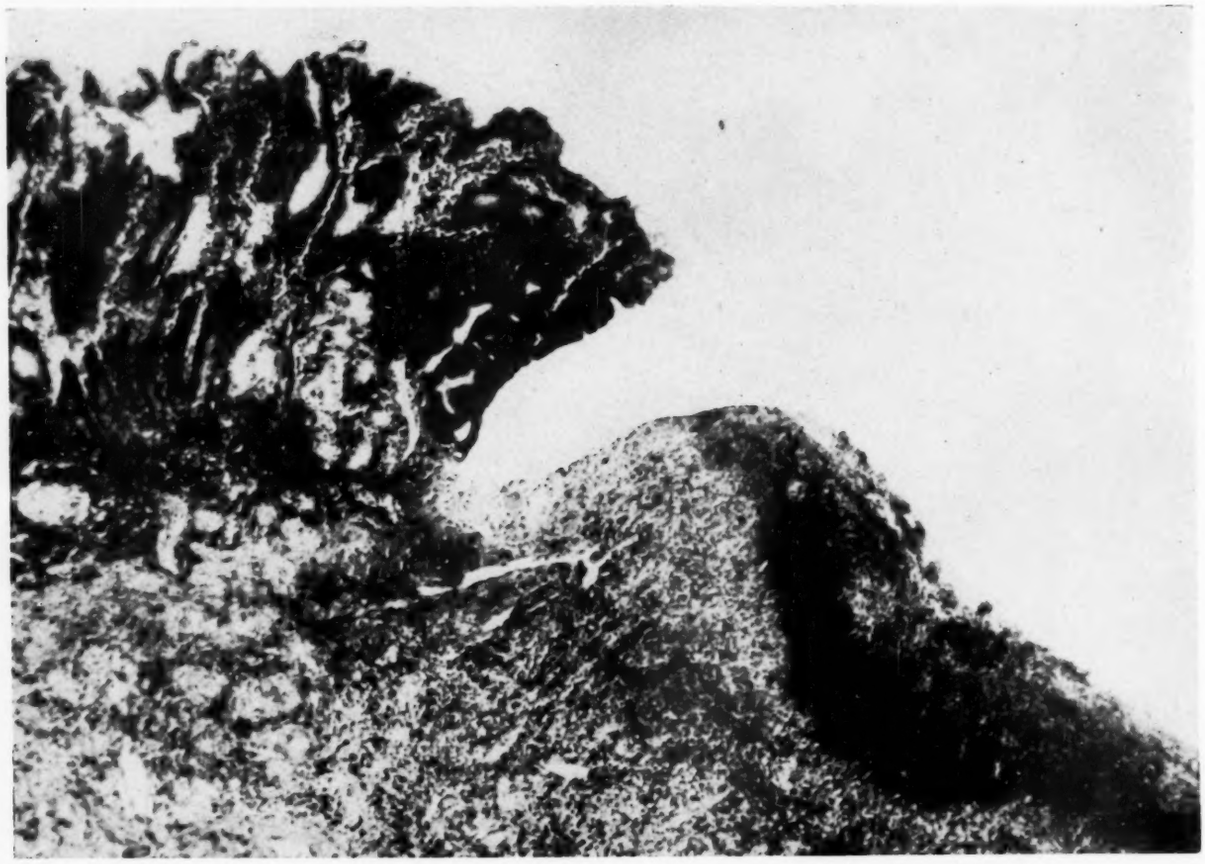

FIG. 3. Left, normal mucosa; right, necrotic ulceration of the stomach (high power field).

essentially negative except for vague abdominal pain of three months' duration occurring only at night. There was no loss of appetite.

The patient was treated with multiple blood transfusions. Subsequent x-rays (Fig. 1) and fluoroscopy revealed a mushroom-shaped ulcer on the greater curvature of the stomach which resembled a large ulcerating carcinoma. Following the transfusions the patient was sent home to recuperate and was to return for surgery when the condition improved.

The patient was readmitted for surgery on September 20, 1954. Hemoglobin on admission was 14.4 gm., red blood count was 4,290,000. All other laboratory findings were within normal limits. A repeat upper gastrointestinal series was performed at the time of readmission and no apparent change in the filling defect on the greater curvature of the stomach was revealed.

Operation was performed on September 22, 1954, under nupercaine® Jones' solution, lumbar block. Exploration revealed that the greater curvature of the stomach was firmly fixed to the pancreas. There was a large amount of induration into the pancreas and the lesion apparently had perforated into that organ. The mesocolon of the transverse colon was indurated, inflamed and had the appearance of metastatic malignancy. The middle colic artery could not be palpated due to the inflammatory edema. The general picture was one of late gastric carcinoma with metastasis to the pancreas and mesocolon. A decision was made to resect the stomach, primarily to prevent subsequent gastric hemorrhage and also bearing in mind the possibility that removal of the primary lesion might slow down the metastatic growth.

A Billroth No. 1 resection of the stomach was performed. When the greater curvature was separated from the pancreas a perforation the size of an adult thumb was found. Examination of the resected specimen revealed that the lesion resembled an ulcer more than a carcinoma.

The pathologic report was as follows: The specimen consisted of a resected portion of stomach measuring 10 by 8 cm. The entire wall

was somewhat thicker than usual and an area from the greater curvature showed a discolored, somewhat indurated, ulcerated area 1 cm. in diameter with a perforation of the ulcer through all layers. On opening the stomach, the mucosa was somewhat hyperplastic. No other areas of ulcers or tumors were found. Microscopic examination of the involved area showed an erosion of the mucosa with a moderate degree of cellular necrosis which extended to the muscularis. (Figs. 2 and 3.) Through the muscle some increased areas of fibrosis were found, as well as a diffuse infiltration with lymphocytes and some polymorphonuclears. The adjacent mucosa and the mucosa of other portions of the stomach showed a slight prominence of the acidophilic cells. The cellular structure was orderly throughout and there was no evidence of any malignant changes. No epithelial invasion could be found in any of the material studied. The diagnosis was peptic ulcer with perforation.

The patient made an uneventful recovery and was discharged on the ninth postoperative day. He was eating six light meals a day and had no unusual symptoms. He has had a progressive recovery since then and is again working as a farmer, with no recurrence of symptoms. Recheck x-ray, (Fig. 4) at six months revealed a small stomach functioning normally.

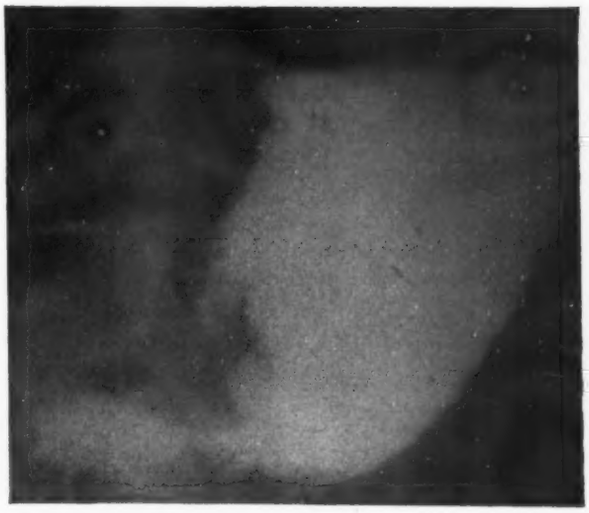

FIG. 4. X-ray of the stomach seven months postoperatively shows no evidence of any filling defect.

COMMENTS

When the surgeon is dealing with a condition that seems hopeless, an attempt should always be made to resect the lesion even if it is only to palliate the condition. The surgeon should take the attitude in dealing with a malignancy that a greater risk can be taken since the patient has more to gain. It is in these seemingly hopeless cases that one is occasionally rewarded with a brilliant result when the patient is returned to health and comfort. In operating, one must keep in mind that when inflammatory lesions in a hollow organ perforate, they cause a progressive eroding process to set up in adjacent organs. This is the picture which leads the surgeon to believe that he is dealing with a malignant lesion.

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Meckel's Diverticulum

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MECKEL'S diverticulum is not commonly found, but it does occur often enough to be considered in the differential diagnosis when a patient has abdominal symptoms. The purpose of this article is to emphasize the importance of this congenital anomaly and to take it out of the "interesting but rare" category. A typical case will be presented in which vague abdominal complaints were the presenting symptoms for three years before surgery was performed. Too often the diagnostic acumen of the examining physician is dulled by the indefiniteness of the clinical picture of Meckel's diverticulitis and surgical intervention is employed only after evidence of a complication. By being familiar with its symptoms, clinical course and difficulties, the doctor will be better able to correlate the presenting symptoms with the findings at laparotomy.

Although Meckel[1] was the first to describe the embryology and clinical significance of this diverticulum accurately (in 1808 and 1812), Lataver[2] presented the original case report in 1672. In 1698 Ruysch[3] recognized such a diverticulum, and Littre[4] in 1742 reported the case of a herniated diverticulum. This type of diverticulum came to be known as Littre's hernia.

When the vitelline duct does not undergo normal involution at the 7 mm. embryonic stage, Meckel's diverticulum is the resulting anomaly. This duct connects the yolk sac with the intestine during the first month of fetal life. Obliteration of the omphalomesenteric duct starts in the fifth week and is ended at the seventh fetal week. If obliteration does not occur, various types of anomalies will result, depending upon the degree of patency of the duct. Persistence of the proximal portion, leading to an outpouching of the intestinal tract, causes the defect known as Meckel's diverticulum.

Possible anatomic variations and their incidence are given by Thompson:[5] (1) the typical diverticulum arising from the antimesenteric side of the ileum, lying free in the peritoneal cavity and presenting a closed distal extremity (82.5 per cent); (2) partial obliteration with a fibrous band running from the tip of the diverticulum to the umbilicus or to some adjacent structure (10 per cent); (3) umbilical fistula (6 per cent); (4) the giant diverticulum of bizarre form or shape sometimes arising from the mesenteric side of the ileum and developing between the folds of the mesentery (0.5 per cent); (5) the umbilical polyp, either attached to the remains of the omphalomesenteric duct inside the abdomen or entirely cut off from internal connection (0.5 per cent); and (6) the simple intramesenteric variety (0.5 per cent).

The primitive digestive tract is made up of an entodermal epithelial lining and a layer of mesoderm forming the splanchnopleure. The epithelial lining of all the digestive glands is developed from these identical cells of the entoderm in the fetus. Albrecht[6] explains the presence of aberrant tissue in Meckel's diverticulum on the basis of this lining entoderm, which includes the omphalomesenteric duct and has the potentiality of developing into any of the glandular elements of the mature gastrointestinal tract. Farr and Penke[7] attribute heterotopia to the fact that the vitellointestinal duct may have a digestive function in early fetal life which would include a complete primitive digestive system. Greenblatt et al.[8] concur with these theories, but add that instead of the early digestive tract disappearing, " . . . a vestige of heterotopic tissue remains as a consequence of normal embryological retrogression of the omphalomesenteric duct."

Pancreatic tissue was found in a Meckel's

diverticulum as early as 1861 and the presence of heterotopic gastric mucosa was recognized in 1904.[9] The secretion of this gastric mucosa is similar to that of the stomach. The flow of pepsin and hydrochloric acid increases at mealtime, pouring out into a relatively empty and unprotected intestinal tract. Mathews and Dragstedt[10] showed that the small intestine becomes progressively more sensitive to gastric juice as the distance from the stomach increases. Therefore the formation of ulcers in the distal ileum associated with aberrant gastric mucosa is not unexpected. When ulceration occurs, it may be located at the neck of the diverticulum or distally in the small intestine and is present in the intestinal mucosa adjacent to the gastric mucosa. Chaffin[11] showed ulceration in diverticula where there was no evidence of gastric mucosa.

Meckel's diverticulum is the most common anomaly of the entire gastrointestinal tract. Mottram and Garland[12] report an incidence at autopsy of approximately 2 per cent in the general population. Rich[13] reported that among 17,000 autopsies performed at the Johns Hopkins Hospital 124 Meckel's diverticula were found, an incidence of 0.73 per cent. Wilson[14] estimated that in approximately 20 per cent of persons with Meckel's diverticula symptoms or complications will develop leading to diagnosis of the condition at operation. Meckel's diverticulum occurs twice as often in males as in females. It is more often symptomatic in the young, the average age of patients in McHardy's[15] series being 19.2 years.

Variations in size, shape and location of the diverticulum are frequent. The length may be from 0.5 to 8.5 cm., the average being 4.4 cm. The base diameter can vary from a few millimeters to a size equal to that of the small bowel. The configuration of the diverticulum may be conical, saccular, vermiform, filiform, hemispheric or sausage-shaped. The usual location of Meckel's diverticulum is the terminal ileum about 20 inches proximal to the ileocecal valve, although this distance may vary from a few centimeters to 192 cm. It originates most frequently at the antimesenteric border of the ileum but can arise at any point from there to the attachment of the mesentery. In order for the surgeon to rule out Meckel's diverticulum completely, the terminal ileum should be transilluminated as diverticula can also be intramesenteric. All of the layers of the muscularis of the intestine are included in the wall of the Meckel diverticulum. Most diverticula contain a definite mesodiverticulum, although the more sessile ones and those less than 3 cm. long may not. On close examination of the latter, the blood supply can be seen coming through the ileal wall into the base of the diverticulum.

Meckel's diverticulum may float freely within the abdomen or it may be attached to the umbilicus. If the free end becomes adherent anywhere intra-abdominally, the danger of future bowel obstruction is always present.

Greenblatt's[8] classification of Meckel's diverticula is an adequate one: (1) incidental (no disease, lined by small intestinal mucosa); (2) inflammatory type (non-specific, trauma, foreign bodies, parasites; and specific, tuberculosis, typhoid); (3) obstructive type (torsion of volvulus, intussusception with diverticulum as starting point, diverticulum knotting around intestine, bands, incarceration in hernia); (4) peptic ulceration (hemorrhage, perforation); (5) tumors (benign, malignant and heterotopic tissue).

The signs and symptoms of Meckel's diverticulitis are variable and are usually the results of complications. Mottram and Garland[12] believe that asymptomatic cases occur more often in proximity to the ileocecal valve, whereas those with surgical complications are more likely to be 50 to 60 cm. proximal to the ileocecal valve. If the diverticulum has a large, wide mouth affording satisfactory drainage, acute inflammatory changes are not very frequent. Merritt and Rabe[16] point out that this opening, however, predisposes to intussusception. The outpouring of secretions from heterotopic gastric mucosa may cause spastic contractions of the diverticulum, leading to vague abdominal discomfort and resembling the continuous gnawing aches of a peptic ulcer. The symptoms are not relieved by antacids or the ingestion of food. Pain is present in most cases and may be periumbilical at first, followed by migration to the right lower quadrant of the abdomen. This is a pattern very similar to that seen in acute appendicitis.

As in intestinal obstruction, pain may be intermittent and colicky, and is caused by rotation of the bowel about the diverticulum, forming a volvulus. Obstruction, accompanied with nausea and vomiting, may occur when the diverticulum is attached to the abdominal

wall or adjacent viscera, forming an opening through which internal herniation may ensue.

The most common symptom of a diseased Meckel's diverticulum is the passage of red blood through the rectum. Haber[17] states that intestinal hemorrhage of unexplained origin should always make one suspect Meckel's diverticulitis. The blood is not mixed with mucus as in intussusception, or pus cells as in colitis. Bleeding may be recurrent and of massive amounts. Jay et al.,[18] reviewing proved cases of Meckel's diverticulitis at the Henry Ford Hospital, found severe rectal bleeding as the predominant feature of many of them. Some patients had ulceration at the edge of the heterotopic mucosa, and in a few the ulcer had perforated by the time of operation. If perforation occurs due to progression of the disease without timely surgical intervention, diffuse-spreading peritonitis results with tenderness and rigidity of the lower portion of the abdomen. Benign and malignant tumors, foreign bodies and calculi may also give rise to inflammation, perforation and intestinal obstruction.

Owen and Finney[19] believe there is a tendency toward ulceration with hemorrhage in the younger age groups where the morbidity and mortality are higher; in older patients intestinal obstruction is more common.

The preoperative diagnosis of Meckel's diverticulitis is seldom made. Roentgen examination of the gastrointestinal tract is hardly ever confirmatory. Mottram and Garland[12] reveal that the literature reports only twenty-one cases correctly diagnosed roentgenologically. These authors employ small water-barium meals which demonstrate a barium collection in the mid- or lower portion of the abdomen not conforming to the shape or appearance of a normal small bowel pattern. The density of the barium collection varies during the day depending upon the extent of its dilution with intestinal contents. The barium may remain after emptying of the small bowel. If the sac is filled with intestinal contents or is small in diameter (less than 3.0 cm.), it may not be demonstrable at all. Diagnosis by x-ray is not used by many since it is difficult and unreliable, owing to the lack of uniformity in the location and size of the diverticulum.

A differential diagnosis should include acute appendicitis, cholelithiasis, diverticulitis of the colon, colitis, torsion of the appendices epiploicae, primary pneumococcic peritonitis, mesenteric thrombosis, acute pancreatitis, perforated peptic ulcer, diseases of the pelvic viscera, hernia with obstruction and perforation of the small bowel. In children the following diseases should also be considered: intussusception, intestinal polyps, hemangioma, volvulus, blood dyscrasia, mesenteric adenitis and dysentery.

Surgical excision is the only treatment for Meckel's diverticulitis. The routine appendectomy technic, in which the base of the diverticulum is crushed, tied and amputated with the stump buried beneath a purse-string suture, is not applicable here. Many factors are contraindications to the employment of this method, i.e., leaving behind remnants of heterotopic gastric mucosa which may later ulcerate or perforate, the possibility of postoperative hemorrhage from unsatisfactory ligation of the blood supply in the wall of the stump, and the danger of intussusception with the stump being the leading point. Ladd and Gross[20] recommend the placing of clamps at a 45 degree angle to the long axis of the bowel in order to produce less constriction of the lumen. The procedure of choice with a perforation is wedge resection of the portion of bowel containing the diverticulum, with end-to-end anastomosis.

The open technic for excision is indicated when the diameter of the base of the diverticulum is large. After clamping the base at an angle with the transverse axis of the bowel and excising the diverticulum, the bleeding points are clamped and tied. A Connell closure of the wound, transverse to the axis of the bowel, is then done.

The prognosis is good in the early surgical treatment of uncomplicated Meckel's diverticulitis, the mortality rate being 3 to 5 per cent.

The following report illustrates a typical case of Meckel's diverticulitis.

CASE REPORT

The patient, an eighteen year old white boy, entered the hospital with the complaint of persistent pain for one month in the right lower quadrant of the abdomen. He had had vague abdominal discomfort intermittently for more than three years. Since the age of fifteen he had had frequent attacks of mild epigastric pain. The onset was gradual and occurred after eating. The pain would last one or two hours

and was never severe enough to require medical attention or bed rest. The type of ingested food was not a precipitating factor. The patient always had normal-colored stools, with no history of change in bowel habits. Two months prior to admission while marching, he noted localized, intermittently sharp and dull pain in the right lower quadrant of the abdomen. After examination by a physician, he was treated with antispasmodics and a bland diet. There was no improvement in the patient while on this medical regimen.

On admission to the hospital physical examination revealed some rigidity with moderate tenderness and slight rebound tenderness in the right lower quadrant of the abdomen. A laparotomy was performed through a right rectus muscle-splitting incision. A Meckel diverticulum, attached to the mesentery by fibrous adhesions, was found 18 inches proximal to the ileocecal valve. After resection of the diverticulum and elective appendectomy, the patient made an uneventful recovery. The patient was seen six weeks after operation and reported that he was asymptomatic for the first time in three years.

Laboratory data revealed a white blood count of 6,150, neutrophils 50, lymphocytes 43, monocytes 5, and eosinophils 2. Urinalysis gave negative results for sugar and albumin, and microscopic examination revealed no abnormalities. On pathologic examination the Meckel diverticulum was found to contain ectopic pancreatic tissue.

SUMMARY

A case is presented of Meckel's diverticulum causing symptoms of three years' duration before severity of the clinical course led to laparotomy and diagnosis.

Meckel's diverticulitis occurs often enough to be considered in the differential diagnosis of the patient with abdominal symptomatology. A brief résumé of its clinical and pathologic features is presented.

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Primary Carcinoma of Bartholin's Gland

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PRIMARY carcinoma of Bartholin's gland is considered to be one of the rarest tumors occurring in the female genital tract; approximately 110 cases have been reported in the literature. Klob[1] first described the lesion in 1864. In 1951 Wharton and Everett[2] presented five new cases and reviewed 104 cases from the literature. This does not, of course, represent the true incidence of the tumor, since there have been differences in criteria and some unreported cases. The tumor appears predominantly in patients between the ages of forty and sixty. The lesion may be either adenocarcinoma or epidermoid carcinoma, with a preponderance of the former. Histologically, the acini of Bartholin's gland are lined with cuboidal cells, and the superficial ducts near the surface are lined with stratified squamous epithelium. The epithelium becomes transitional as the duct nears the gland.[3]

Honan[4] gave four diagnostic criteria which must be met in order to be certain of primary Bartholin gland origin: (1) typical vulvar sites, (2) position deep in the labium, (3) connection with the duct of the gland and (4) the presence of intact gland tissue. Te Linde[5] states that the chief point of clinical distinction in the early stages of the disease is a small painless nodule in the position of Bartholin's gland which is covered externally with intact integument. As the growth extends, it may become painful and then necrotic. The mass may then feel fluctuant and may be confused with a cyst.

The recommended treatment at the present time is the Bassett operation. Taussig[6] suggests that this be performed in two stages: excision of the vulva, and two weeks later bilateral inguinal and femoral lymphadenectomy. These tumors are believed to be radioresistant but radiation should be used following the radical operative procedure in order to give the patient every chance for recovery. Regardless of treatment, the prognosis in this disease is poor. In nine of 110 cases in the literature patients have survived five years without residual tumor. Finn and McFadden[7] recently reported one case of epidermoid carcinoma of Bartholin's gland with a five-year survival.

The following case is one of primary adenocarcinoma of Bartholin's gland treated surgically.

CASE REPORT

B. P., a forty-eight year old white woman, was admitted to the Herbert J. Thomas Hospital on February 25, 1954. Her chief complaint was chronic discharge from a lump in the left labium for the past year. The mass had been opened and drained in a physician's office on two occasions but had not healed.

The past history was significant in that fifteen years previously there had been an abscess in the same region which had required drainage.

On physical examination the only abnormalities were limited to the vulva and inguinal lymph nodes. The latter were slightly enlarged bilaterally and were rubbery to palpation. Beneath the skin surface of the left labium a firm, hard, movable mass measuring 4 cm. in diameter was felt. The location corresponded to Bartholin's gland. The vaginal mucosa was slightly irritated with a moderate amount of leukorrhea. The cervix was small and smooth. The uterus was small and retroverted. The adnexal areas presented no unusual findings. The laboratory studies were essentially negative.

On February 26th wide excision of the "infected" Bartholin's gland was performed. The pathologic diagnosis was primary adenocarcinoma of Bartholin's gland. A radical left vulvectomy, and dilatation and curettage were performed on March 16th. Two days later a

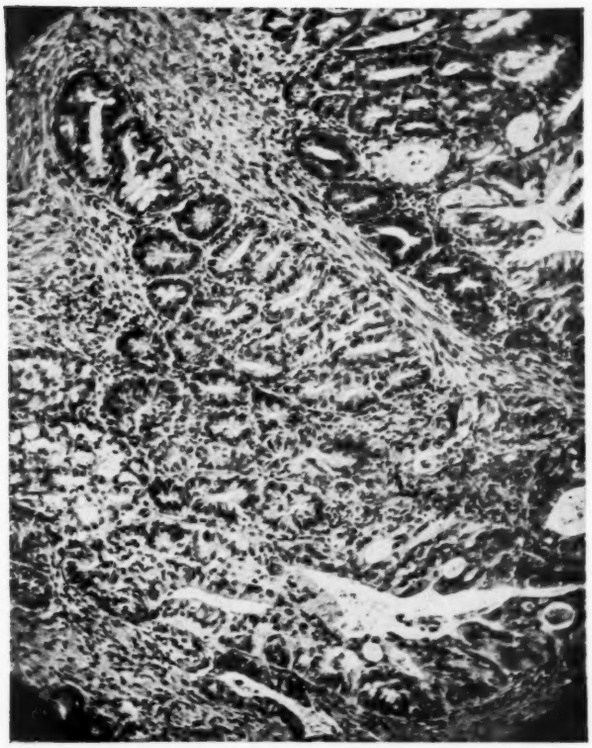

FIG. 1. Well differentiated adenocarcinoma of Bartholin's gland. Original magnification, × 100.

FIG. 2. Adenocarcinoma with vacuolated cells. Original magnification, × 30.

radical bilateral ilioinguinal lymph node dissection was performed. Convalescence was good and the patient was discharged on March 28th 1954.

On pathologic examination the first specimen was an oval tissue that measured 4 by 3 by 3 cm. It was semi-firm and on section was gray-white and granular. The surface of the tissue was irregular. Microscopic examination showed identifiable Bartholin's gland which contained an infiltrating adenocarcinoma. It was composed of small to large acini which were lined with single or multiple layers of cuboidal or columnar epithelial cells with frequent pseudo-papillary projections into the lumen. The nuclei of the tumor cells were round or oval and hyperchromatic. The cytoplasm was moderate in amount and granular or vacuolated. The specimens from the second and third operations consisted of a radical left vulvectomy with dissected lymph nodes. On microscopic examination adenocarcinoma similar in histopathology to the original tumor was found in the upper left iliac-inguinal nodes. The other lymph nodes showed only non-specific lymphoid hyperplasia. (Figs. 1 and 2.)

The final diagnosis was primary adenocarcinoma of Bartholin's gland, with metastases to the left iliac and inguinal lymph nodes.

On November 5th an elective laparotomy was performed. This procedure was done because of the patient's survival for eight months without clinical evidence of recurrence of tumor or metastasis. At operation a thorough search of the abdomen failed to reveal any evidence of malignancy. The patient was last seen in the Tumor Clinic in February, 1955, at which time she was completely symptom-free and physical examination was negative.

COMMENT

This case of primary adenocarcinoma of Bartholin's gland is presented because it occurs uncommonly and we would like to add it to those already reported. The tumor had metastasized to the left inguinal and iliac lymph nodes. Treatment was by radical vulvectomy and ilioinguinal lymph node dissection. The latter procedure was performed by a modification of previously reported technics.[5] This method consists essentially of dividing the inguinal ligament and anterior abdominal muscles from the anterior-superior iliac spine and crest. This technic enables one to remove

the iliac, obturator and inguinal lymph nodes by block dissection extraperitoneally.

SUMMARY

A case of adenocarcinoma of the left Bartholin's gland with metastases to the left inguinal and iliac lymph nodes is reported.

A "second look" procedure eight months after radical surgery showed no evidence of recurrence of the tumor or metastases. Treatment by radical surgery of the local lesion and the regional lymph nodes is advocated.

ADDENDUM

When last seen (July 13, 1956) the patient was feeling well and was free of tumor recurrence and metastases.

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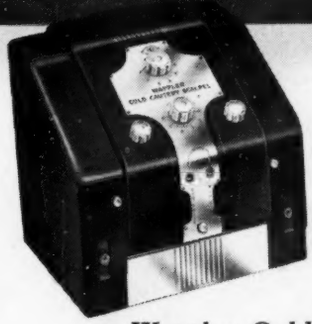

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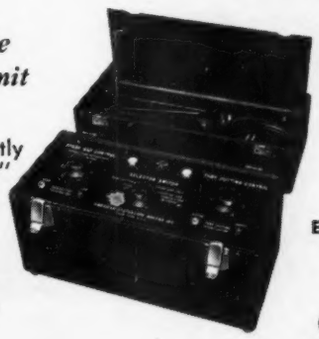

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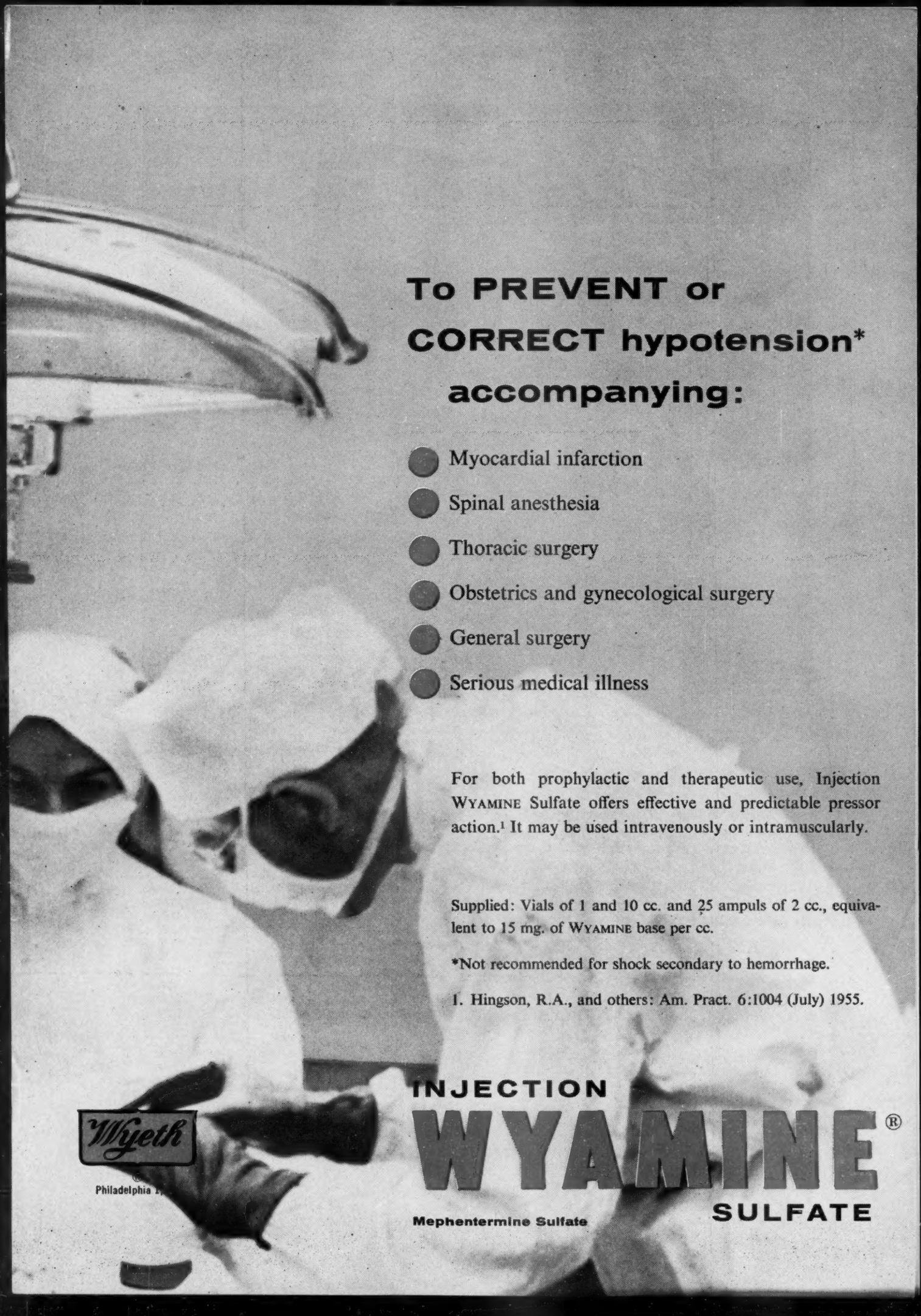

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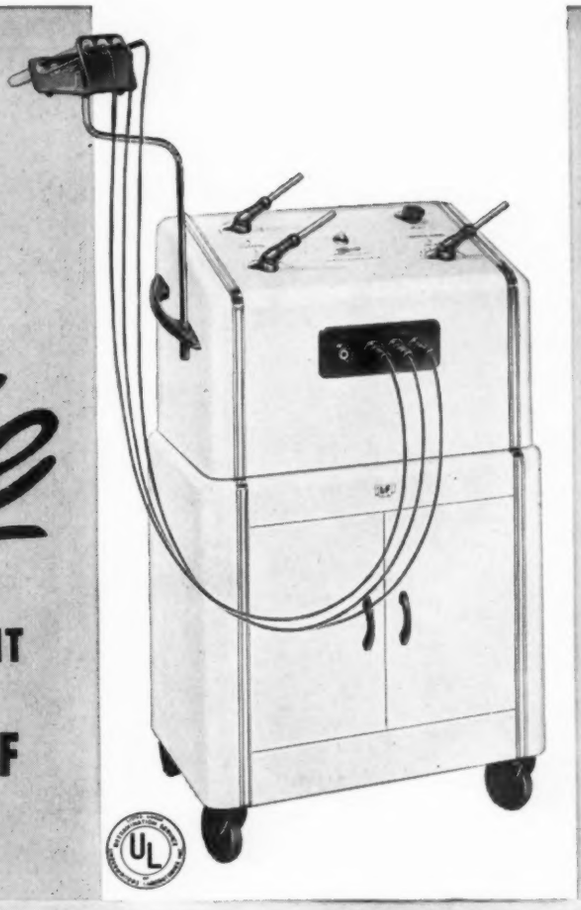

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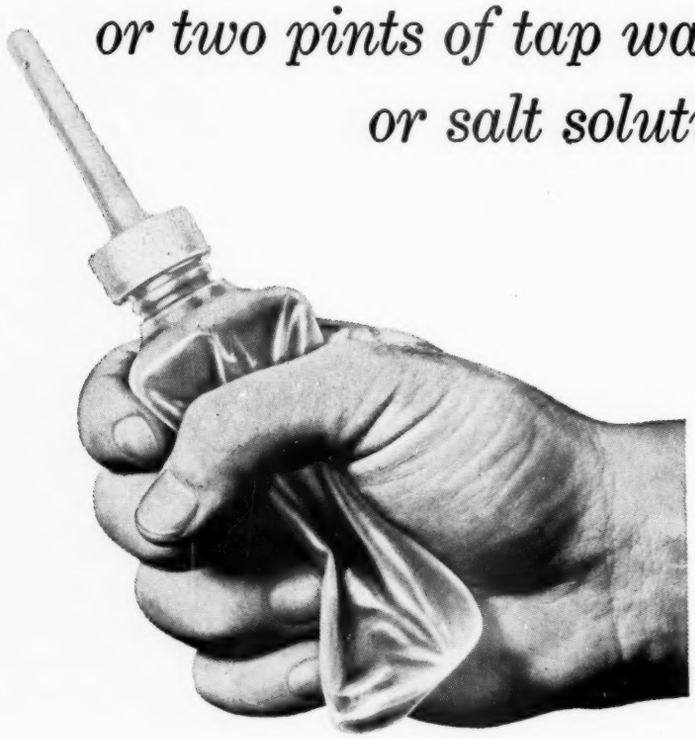

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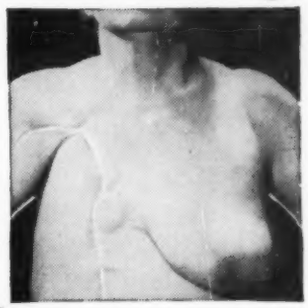

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1. Grayzel, H. G., Helmer, C. B., and Grayzel, R. W.: New York St. J. Med. 53:2233, 1953. **2.** Helmer, C. B., Grayzel, H. G., and Kramer, B.: Archives of Pediatrics 68:382, 1951. **3.** Behrman, H. T., Combes, F. C., Bobroff, A., and Leviticus, R.: Ind. Med. & Surgery 18:512, 1949. **4.** Turell, R.: New York St. J. Med. 50:2282, 1950. **5.** Marks, M. M.: Missouri Med. 52:187, 1955.

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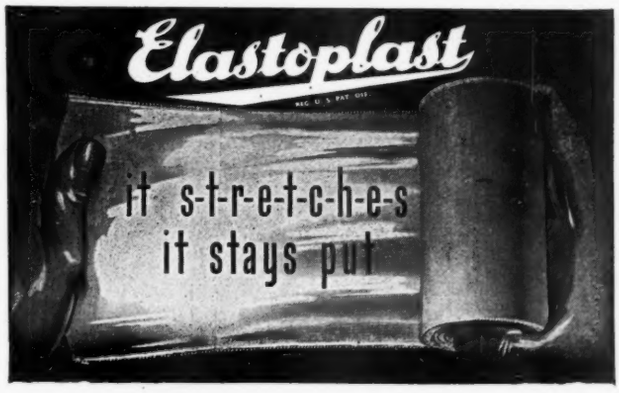

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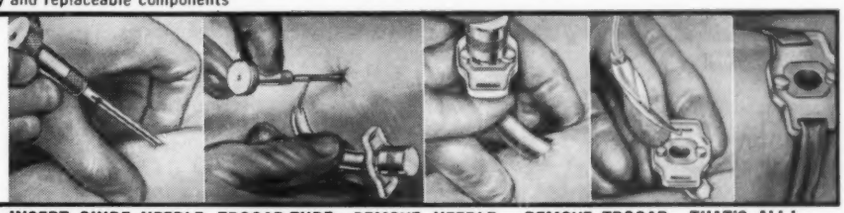

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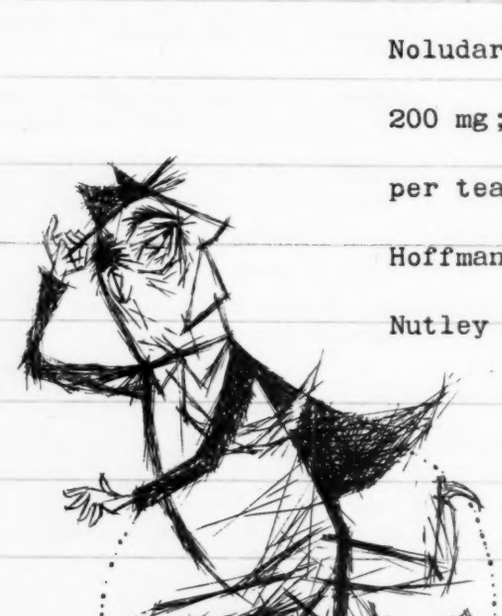

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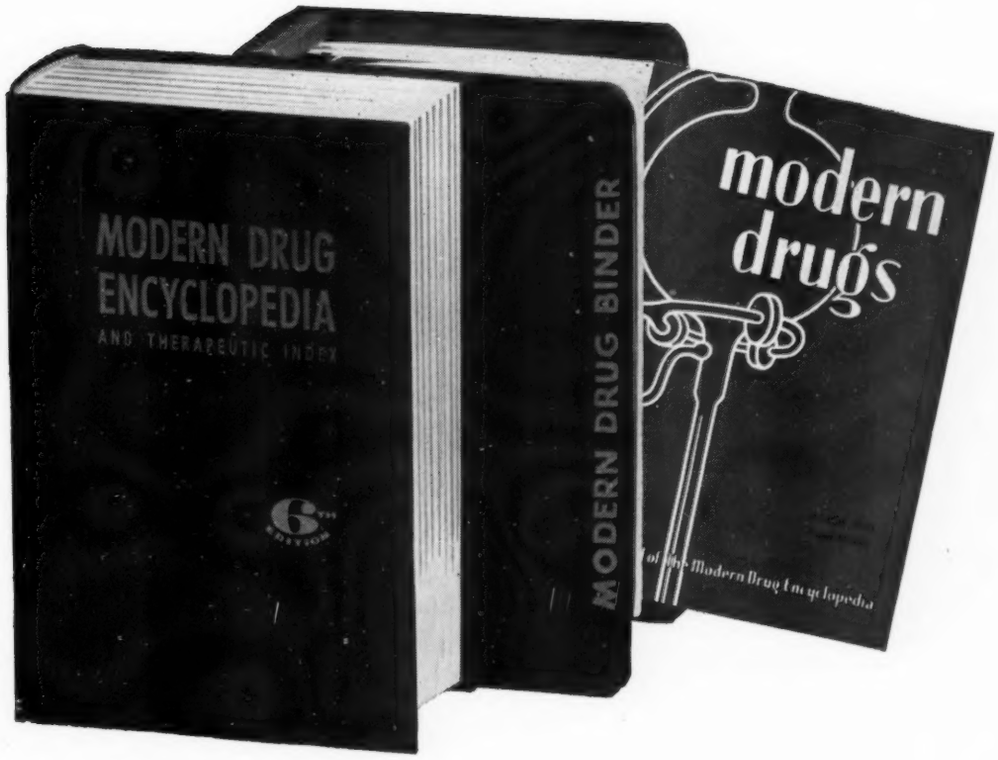

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NOTES AND QUOTES

SOME time in 1957 Appleton-Century-Crofts, Inc., will publish "Atlas of Technics in Surgery" by Dr. John Madden. The aim of the Atlas is to show detailed steps in the performance of the operations illustrated. The operations have all been performed by the author and observed by the illustrator so that actual operating room technics are portrayed. The aim of the author and the illustrator is to be factual and realistic, relative to the anatomy of the particular operation. Frequently in illustrations of operations too many hiatuses exist which make it difficult for the surgical trainee to interpret properly the in-between steps which are not illustrated. This factor is overcome in Dr. Madden's book. Descriptive legends are placed on one page, with illustrations on the facing page. This book is planned for the practicing surgeon but emphasis is placed on the needs of interns and residents.

The American Journal of Surgery feels it is an honor to be able to reproduce from time to time a few of these operations before publication of Dr. Madden's work. This Atlas is an appropriate gift for the young surgeon or surgical trainee. An outstanding work. [*Editor.*]

In publishing the list of the names of fifty-eight winners of the Alfred P. Sloan National Scholarships, the Sloan Foundation has also announced an expansion of its scholarship program. Originally limited to some 100 scholarship stipends tenable at four institutions, the program in the future will embrace thirteen colleges and universities and make awards to some 240 students. Two institutions have been added to the program during the last month. They are the Case Institute of Technology, Cleveland, Ohio, and The Johns Hopkins University School of Engineering, Baltimore, Maryland.

The eleven institutions previously participating in the scholarship program are: Albion College, Albion, Michigan; Amherst College, Amherst, Massachusetts; California Institute of Technology, Pasadena, California; Carnegie Institute of Technology, Pittsburgh, Pennsylvania; Cornell University, College of Engineering, Ithaca, New York, Dartmouth College, Hanover, New Hampshire, Massachusetts Institute of Technology, Cambridge, Massachusetts; Oberlin College, Oberlin, Ohio; Stanford University, Stanford, California; Wabash College, Crawfordsville, Indiana, and Williams College, Williamstown, Massachusetts.

By 1960, when this scholarship program thus expanded is fully operative, it is anticipated that the Foundation's annual expenditure will exceed $420,000 *and that its total commitment for the program will be in excess of* $1,000,000.

MARRIAGE as a way of life is at peak popularity among American men. In number, American husbands have reached a record high, totaling nearly 39,000,000 in the civilian population alone.

The typical American at present marries at a relatively early age, establishes his own household soon after marriage, and keeps his nose to the grindstone to the extent that he bears responsibility for raising a family throughout most of his working life. About 95 per cent of all married men under age sixty-five are gainfully employed.

These facts are derived from a statistical profile of the American husband by the statisticians of the Metropolitan Life Insurance Company, using largely data from the Bureau of the Census.

Five of six patients with tuberculosis who are intolerant to paraaminosalicylic acid (PAS) or its sodium salt are able to take the potassium salt now being marketed by Eli Lilly and Company as pulvules 'paskate' (potassium aminosalicylate, Lilly). The new form of this therapy thus enables as high as 94 per cent of all patients with tuberculosis to take it without the extreme nausea, vomiting and diarrhea that limit the usefulness of PAS in its other forms. Clinical tests show that because of its greater solubility 'paskate' gives higher blood concentrations of PAS than equal doses of sodium PAS. Also, this new form contains no water or hydration and hence provides, gram for gram, 11 per cent more PAS for absorption than does NaPAS.

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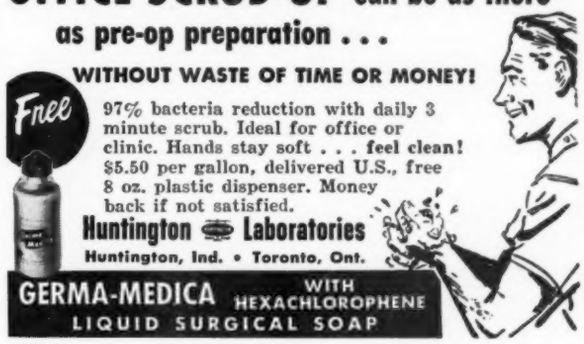

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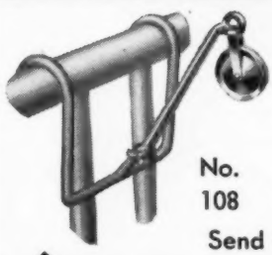

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Following the Annual Meeting and completion of the Part II Examinations of the American Board of Obstetrics and Gynecology, the following statistics were compiled: Of the total number of 471 *new and reopened applications this year,* 108 *were postponed by the Credentials Committee. Four hundred thirty candidates took the Part I Examinations, and of forty-eight failures in this group, twenty-five were failures in the Written Examinations and twenty-three were in Case Reports. There were a total of* 416 *candidates who participated in the Part II Examinations,* 317 *were certified and ninety-nine failed.*

Applications for certification for the 1957 *Examinations are now being accepted. All candidates are urged to make such application at the earliest date possible. Deadline date for receipt of applications, new and reopened, is October* 1st.

Current bulletins outlining present requirements may be obtained by writing to Dr. Robert L. Faulkner, American Board of Obstetrics and Gynecology, 2105 *Adelbert Rd., Cleveland, Ohio.*

RECENTLY we had occasion to refer to a bound volume of this Journal (volume 52, page 513, 1941). Having finished our immediate task, we glanced idly through the pages; now and then we read part of an article. In the June, 1941, issue we noted an article entitled "Obstructing Chronic Cicatricial Enteritis Treated with Simple Lateral Anastomosis: Ten-Year Follow-up" by Dr. Edwin J. Grace of Brooklyn, New York. In view of President Eisenhower's recent illness, operation and recovery, our interest was aroused, particularly because recently many lay feature writers, surgeons famous within the confines of the 6th Ward, and Monday morning scientific managers broke into print howling "they" would have resected the diseased intestine rather than have done an anastomosis.

Dr. Grace's patient, a thirty-seven year old woman, had consulted and been treated by several doctors over a two-year period. Appendectomy had been performed with no improvement. Dr. Grace made a working diagnosis of chronic ulcerative colitis. On April 9, 1930, side-to-side ileocolostomy was performed to relieve the obstruction in the ileum. The patient made an uneventful recovery. Dr. Grace followed her course for ten years and then wrote his paper. At that time he concluded, "In view of the excellent result ten years after conservative measure of ileocolostomy, this case should be added to the accumulating evidence warranting an open mind toward conservative therapy in this type of disease."

We recently communicated with Dr. Grace and asked if the patient had suffered any setback after his report in 1941 and, if alive, what the state of her health was at the present time. The patient is very much alive, and except for minor, everyday illnesses she has enjoyed robust health. It is now twenty-six years since the operation was performed.

Our only comment concerning the veiled criticism of what might happen to the President in the future, and what his physicians should have done is this: if we ever have this intestinal ailment, we would hope to be treated by such doctors of medicine as those who attended President Eisenhower. [*Editor.*]

Important gains have been made in reducing the heavy loss of life among babies during the later stages of pregnancy and soon after birth, but such mortality still constitutes "a medical and public health problem of major proportions," according to the Metropolitan Life Insurance Company's statisticians.

Perinatal mortality (defined as fetal deaths after twenty or more weeks of gestation and infant deaths within the first week of life) declined steadily in the United States from a death rate of 51.4 *per* 1,000 *live births in* 1940 *to* 35.0 *in* 1953.

Despite this progress, more than 136,000 *such deaths were recorded in* 1953. *Of this number, about* 69,000 *were stillbirths and* 67,000 *were liveborn children who died before they were one week old. The latter figure alone is twice the number of deaths that occur yearly among children in the age range from one to fourteen years. Premature birth was reported as an associated condition*

CONTINUED ON PAGE 52

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in a majority of fatalities within the first week.

"The major promise of future gains in reducing perinatal mortality rests in research into the specific conditions and factors related to immaturity," the statisticians report. "Greater attention needs to be focused on the special medical and nursing services required by immature infants, who constitute so large a proportion of the babies who die in the perinatal period."

THE LIFE INSURANCE MEDICAL RESEARCH FUND announced recently that it has awarded $960,340 in grants and fellowships to aid research on heart disease this year. The new awards bring to $8,161,170 the total of the Fund's contributions to this vital work since its organization in 1945. This year's allocation includes $849,640 as grants-in-aid for fifty-eight heart research programs and $110,700 to support twenty-two fellowships for young men and women in training as research workers. Studies will be conducted in forty-nine institutions in various parts of the United States, in Canada, England and the Netherlands.

In announcing the 1956 grants and fellowships, Dr. Francis R. Dieuaide, Scientific Director of the Life Insurance Medical Research Fund, said they would enable scientists to study many of the problems that must be solved to make possible the control of hardening of the arteries and high blood pressure. Prominent among the subjects of research are causes of coronary artery occlusion. Improved methods of treatment for present sufferers are also being searched for.

Diseases of the heart and arteries are now by long odds the chief cause of death. Their fatal impact falls on those in the prime of life, as well as on the aged. While much remains to be done to enable us to prevent these deadly maladies, the outlook today is one of confidence in ultimate success, whereas ten years ago an attitude of despair prevailed.

The Life Insurance Medical Research Fund is supported by contributions from 150 large and small U. S. and Canadian life insurance companies. Its resources are devoted entirely to the fight to gain control of heart disease.

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The Alfred P. Sloan Foundation, Inc. recently made a grant of $150,000 to the Menninger Foundation, Topeka, Kansas, in support of the Menninger School of Psychiatry. In accepting the grant, Dr. William C. Menninger, Secretary of the Menninger Foundation, said, "One of the major factors retarding our advance towards the conquest of mental illness is the critical shortage of properly trained personnel, particularly psychiatrists."

The Menninger School of Psychiatry, currently observing its tenth anniversary, is one of the nation's largest training centers for psychiatrists and it has been a significant influence and inspiration in the nationwide expansion of psychiatric education which has taken place during the last ten years.

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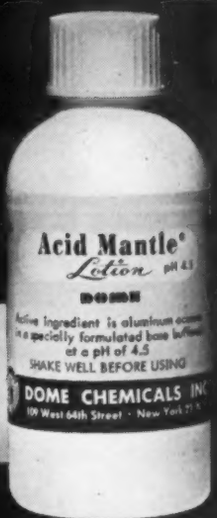

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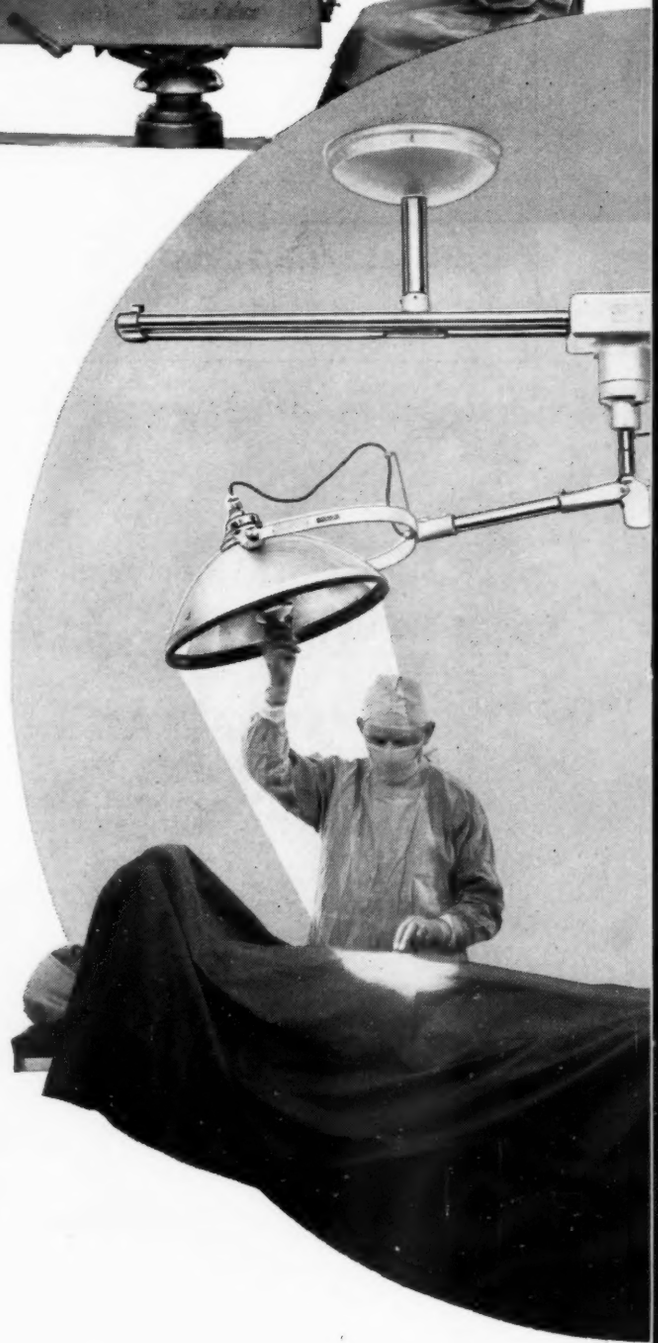

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